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EDITORIAL

Palm Oil for Edible Purposes.

Hitherto, palm oil has found its most extended use in the manufacture of soap and candles. As is well-known, the great source of supply of this oil was the West Coast of Africa where there exist extensive forests of this palm. Palm oil extracted by primitive methods has long been part of the staple diet of the West African native, being employed as an edible and cooking oil.

It is probable that at the time when the great increase in demand for edible oils took place, the claim of palm oil in this connection was overlooked on account of the fact that available supplies from Africa were of low quality, the acidity being anything up to 50 per cent. At that time, methods of refining oil were less developed than at present and the manufacturer of edible oil products had, perforce, to look elsewhere for his raw material. This he found in a number of vegetable oils, and in addition whale oil.

The edible oil market was established before the advent of plantation palm oil. Consequently palm oil, although of high quality, has not yet found any extensive use for edible purposes, a fact which will probably react unfavourably on the plantation industry in a few years time when the quantity of such oil will have assumed large proportions.

The infant industry, if such we may designate palm oil for edible purposes, has, therefore, to overcome the prejudices of the manufacturer, who has adapted his factory methods to the use of other oils, and also the prejudices of the consumer who sees, or thinks he does, objectionable features in palm oil for edible purposes.

It has been stated that the use of plantation palm oil for cooking purposes, without purification, results in digestive troubles. Malays, Chinese and others who have tried it in the "raw" condition have also objected to it on the score that it gave the food an unpleasant taint. On the other hand, we know of an occasion when plantation palm oil, without preliminary treatment, was used for cooking purposes for one week at a Camp, and the men, Malays, Chinese, Indians and Eurasians made no complaint, presumably because they did not detect any unpleasantness.

The utilisation of palm oil for edible purposes is a factor of some importance in Malaya at the present time, when it is desirable to encourage local industries

and at the same time to satisfy the Asiatic demand for a cheap and good edible oil.

The normal Malayan annual demand for oils and fats for cooking amounts to about 12,000 tons of groundnut oil and 8,000 tons of groundnuts, together valued at about $5,000,000, and about 1,000 tons of ghee valued at about $1,000,000. In addition, a large quantity of coconut oil is used, but this is supplied by local production.

In an article in this number, entitled "Bleaching of Palm Oil", Messrs. Georgi and Gunn Lay Teik discuss the methods of bleaching the oil and point to the possibilities of its use locally for edible or soap-making purposes.

Without, therefore, considering the export of palm oil for edible purposes, there does appear to be an opening for the marketing of palm oil for consumption in Malaya.

In order to achieve success in this direction it is essential that the oil should be of good appearance and that the price at which it is sold retail should be attractive. In view of the reduced spending capacity of the public at the present time, the marketing of a cheap edible palm oil should go far to overcome prejudice against its use.

Tobacco Experiments.

An article was included in this journal recently giving a general account of the cultivation of tobacco in Malaya, based very largely on the experience gained with this crop at the Government Experimental Plantation, Serdang. In the present number we carry the subject a step further by giving some account of the experiments carried out with this crop in Singapore.

Labour for tobacco cultivation is at present cheap and plentiful. The tobacco planter also has the advantage of growing a crop which gives an early monetary return. He is, moreover, at present materially assisted by the import duty on tobacco. In view of the large consumption of tobacco in Malaya and bearing in mind the above advantage, it is easy to arrive at an unbalanced view of the probably favourable result of planting tobacco on a large scale at the present time.

Lest readers should accuse us of misleading optimism we would again point out that the demand for low grade tobacco is easily satisfied and offers no good prospects for the large-scale planter. The results so far achieved with better grade tobacco are encouraging but have not yet reached a stage at which they may be definitely recommended for local planting. In particular, a great deal of investigation awaits the experimenter in connection with the curing of the leaf. It is a problem that cannot be solved altogether by the experience of other countries; it has to be solved in Malaya because of the climatic and other conditions peculiar to this country.

It is hoped that planters who are working on this crop in a private capacity, will present their difficulties to the Department of Agriculture. We trust that the article now published in this journal may be useful in this connection. We would add that it is hoped that the next number will contain the third of this series of articles, dealing with pests, the ever urgent problem in tobacco cultivation.

Original Article.

TOBACCO EXPERIMENTS AT SINGAPORE

BY

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Introduction.

Recent trials have been conducted with the cultivation of Virginia types of tobacco, with the object of ascertaining what possibilities may exist for replacing, to some extent, the present large foreign imports of cigarette tobacco by a locally grown leaf.

Conditions governing the production of different types of tobacco vary considerably and, in this instance, trials carried out at the Agricultural Station in Singapore under the immediate control of the writer have been confined solely to the Virginia cigarette types which are often referred to as "Yellow Leaf". The success already obtained is sufficient to justify more extensive experiments.

It is only possible, at present, to deal with production from the sowing period up to and including harvesting operations. Sufficient information is not yet available on which to base any definite recommendations for curing. It has been found, however, that air curing is impracticable under local climatic conditions.

Attempts have been made to cure a few leaves by the application of artificial heat. The results have been encouraging and indicate that it may be possible to produce a marketable leaf by the introduction of a method of flue curing.

Soils.

The soil at the Singapore Station is of a quartzite formation and is in an extremely poor state of fertility, having previously been under neglected pine-apple and rubber cultivation. In spite of this condition, some promising results have been obtained after the application of suitable fertilisers.

Climate.

Climatic conditions represent one of the principal problems which have to be faced in Malaya. The quality of Virginia leaf is largely governed by rainfall, but by careful selection of planting dates it may be found possible during normal seasons at least, to avoid the most adverse conditions.

Excessive rainfall during the growing period, more especially towards the latter stage, was found to result in a leaf lacking both in body and in oil. In addition the damage caused by leaf spotting fungi was found to be greater during a wet than during a dry period.

The most suitable planting dates for the island of Singapore range between the end of January to about the middle of March. Planting between these dates will enable the harvest to be reaped by the end of July, which is usually a dry month.

Preparation of Nurseries.

The nursery beds were prepared in the manner described in the November number of this journal on page 562 and were shaded with cheese cloth.

Fertilising the Nursery.

A suitable fertilising mixture has been found to be one containing 6 per cent. of ammonia as ammonium sulphate, 10 per cent. phosphate as superphosphate and 8 per cent. of potash as potassium sulphate. This mixture was applied at the rate of 4 lbs. to every 10 square yards of nursery planted and was gently raked in just before the sowing of the seed.

Improved growth from weakly seedlings has been obtained by watering them with a weak solution of nitrate of soda at the rate of one half pound to 8 gallons of water per 10 square yards of bed. Immediately after this application the beds were thoroughly watered to prevent injury to the young leaves by direct contact with the nitrate of soda.

Transplanting.

The land to which the young seedlings were to be transferred was marked out in rows 3 feet 6 inches apart and half the intended dressing of fertiliser was applied along these rows three or four days before transplanting commenced. The seedlings were transplanted in the manner described elsewhere during the cool of the afternoon and were spaced 2 feet 6 inches apart in the rows. The seedlings remaining in the nurseries were watered with a weak solution of nitrate of soda as described above and kept for use as supplies. The second half of the fertiliser dressing was applied by sprinkling round the base of the plants three weeks after transplanting.

Harvesting.

Some ninety to a hundred days after transplanting the leaf was ready for harvesting. This condition was denoted by a tendency of the leaf to a slightly mottled yellowish appearance. Furthermore, the midrib of the leaf at the tip snapped clean when bent between the thumb and forefinger. Ripening commences from the base of the plant and two to four of the bottom leaves were removed from each plant as they ripened. Harvesting was undertaken at intervals of three to four days until the whole of the crop was collected.

Immediately after harvesting the leaf was taken to the barn in small bulks, allowing as little exposure to the sun as possible. On arrival at the barn the leaves were strung back to back on sticks and the curing stage commenced.

Tobacco plant after topping.

Tobacco Nurseries.

TOBACCO PLANTS : UNFERTILISED.

TOBACCO PLANTS : FERTILISED.

Curing.

Owing to unfavourable climatic conditions in Singapore it has been found impossible to obtain a satisfactory air cure, more especially as the local climatic conditions are exactly those which favour the bacterial infection known in the industry as "Pole Burn". It appears therefore, that the introduction of flue curing will be necessary in order to overcome the difficulties presented by local atmospheric conditions.

Fertilising.

Small fertiliser trials have been conducted. It is not possible to draw any final conclusions from returns from one small set of experiments, but the results gives some indication of the lines to be followed in future trials.

When selecting the ingredients for a fertiliser it is important to provide the nitrogen in a suitable form and to use potassium sulphate to supply the potash in preference to muriate of potash or kainit.

Successful returns have been obtained from a fertiliser mixture containing 6 per cent. ammonia, 10 per cent. phosphate and 8 per cent. potash in the form of ammonium sulphate, super-phosphate and potassium sulphate respectively. Three rates of application were put down, plots being treated with 600 lbs., 800 lbs. and 1,000 lbs. per acre respectively; half of each of these amounts was applied to individual plots three days before transplanting, and the remaining half three weeks later. Growth in each case was satisfactory, but for poor and medium soils 600 lbs. to 800 lbs. per acre of the mixture should result in good returns; any excess quantity appears to be both wasteful and unnecessary.

Yields from the 600 lbs. and 800 lbs. plots ranged from 6,000 lbs. to 7,500 lbs. of green leaf per acre. equivalent to approximately 900 lbs. and 1,100 lbs. of cured leaf. No increased yields were obtained from the higher applications.

The use of cattle manure applied three months before transplanting at rates varying from 10 to 20 tons per acre, all yielded negative results, growth showing very little improvement on that of the plants on the control plots. It is, however, curious to record that plots treated with a mixture containing 6 per cent. ammonia, 10 per cent. phosphate and 8 per cent. potash applied at rates varying from 600 lbs. to 800 lbs. per acre also yielded negative results. In this instance, however, a portion of the nitrogen supplied was in an organic form, the complete mixture being applied one half just before planting and the remainder three weeks later. It is considered possible that had the organic nitrogen been applied some time previous to planting results might have proved more successful. Further experiments in the use of organic forms of nitrogen are required.

A further set of plots was laid down and treated with cattle manure at rates varying from 10 to 20 tons per acre with the addition of 400 lbs. of the complete inorganic fertiliser described above. The resulting growth in all cases was entirely satisfactory, but cattle manure in large quantities is expensive owing to heavy transport charges and the usually poor quality of local supplies. In these experiments the dressings of cattle manure were made three months before transplanting.

Pests.

The Bud Worm (*Heliothis flavigera*) caused damage during the earlier growing period after transplanting. As a control measure dusting with a mixture of one part lead arsenate powder to 100 parts of tapioca flour combined with hand picking of the caterpillars was found to be satisfactory. During dry weather one application of the dusting powder in every three or four days was sufficient, but if rain intervened re-dusting was necessary. In the nursery, hand picking was carried out during the earlier stages, but was substituted by spraying with a mixture of one pound of lead arsenate powder or two pounds of paste in 50 gallons of water.

The caterpillars, (*Agrotis ypsilon* and *Prodenia litura*) caused some damage by attacking plants just below or at ground level. The damage occurred during the night; in the day time the caterpillars lie concealed just below the surface soil at the base of the plants. These pests were controlled by searching for and destroying the caterpillars.

The stem borer (*Phthorimaea heliopa*) was probably one of the most destructive pests encountered, attacked plants being invariably killed. This pest entered just above the crown and bored into the stem. All infected plants were removed and destroyed.

Various grass hoppers at times caused leaf damage. Dusting the entire plant when the dew was on the leaf with the lead arsenate and tapioca flour mixture described above usually proved an effective measure of control.

Diseases.

"Frog Eye" spot caused by *Cercospora nicotiana* attacked the leaves of plants both in the nursery and in the field. This disease appeared first on the bottom leaves of plants in the nursery. Since strong healthy plants are always more disease resistant, nursery beds in which the seedlings showed any weakness or failure to make normal growth were watered with a solution of nitrate of soda at the rate of one half pound to 8 gallons of water. The beds were also sprayed with Bodeaux Mixture. In the field, removal of infected leaves at an early stage was found to assist in preventing further spread.

"Damping Off", possibly caused by *Rhizoctonia solani,* also appeared in the nurseries. To overcome it the plants were watered with nitrate of soda and care was taken to avoid excessive watering since the spread of the disease is encouraged by the presence of weakly plants and of excess soil moisture.

Alternaria spot caused by *Alternaria tabacina* a fungus disease similar in appearance to "Frog Eye," but revealing larger spots and appearing on the stem as well as the leaves, was also thought to be present on older plants in the field. No confirmation of this was actually obtained, but it is undoubtedly a disease which would be encouraged by local conditions.

Wilt or slime disease caused by *Bacillus solanacearum* attacked some plants at the Station, conditions most favourable for its appearance being warm wet weather and damp soil conditions. The only known method of control is by means of crop rotation.

Individual plants exhibiting curling and distortion of the leaves, sometimes coupled with stunting of the plants, were also found at the Station. Symptoms of this nature have been described under the terms Trenching, Crinkling and Leaf Curl but each of these terms cannot yet be considered as indicating a definite disease, since each is often applied in different localities to differing groups symptoms of which the cause in some cases is as yet obscure.

Marketing.

There exists a fairly considerable potential market for a suitable locally grown cigarette leaf to replace to some extent the existing large imports of foreign leaf, but it must be realised that for sale in this market local leaf must conform to the standard of quality required by the buyers.

Conclusion.

These experiments in the cultivation of Virginia tobacco have revealed favourable possibilities, but curing must be further investigated before any definite conclusions can be drawn as to the quality or market value of the leaf which can be produced. The results obtained in these cultivation experiments justify the undertaking of experiments with flue curing.

SOME PRELIMINARY OBSERVATIONS ON THE COFFEE BERRY BEETLE BORER, *STEPHANODERES (CRYPHALUS) HAMPEI* Ferr.

BY

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Government Entomologist.

Introduction.

This Scolytid beetle is an introduction into Malaya and is an important enemy to the coffee berry in this as well as in other countries. It was first discovered in Selangor in January, 1929, when an immediate survey of the coffee areas indicated that it was generally distributed and had for sometime been present in Malaya. The manner of its introduction and the date of its importation are uncertain but it seems probable that it was conveyed either from Java or Sumatra in consignments of seeds for planting purposes. Its original home is Angola from whence it has spread in Africa to Uganda, Tanganyika and Kenya (1929). Its presence in Nyasaland and Rhodesia has not been recorded. It was imported from Africa into Java about 1909, and from there introduced into Borneo and Sumatra probably about 1919, and into the Brazilian State of S. Paulo in 1924. It was reported in South India in 1930, but subsequently the beetle was identified as *Stephanoderes uniseriatus* Egg. Its presence in the West Indies has been reported and in Europe in coffee beans for consumption. In Malaya, it is not present in all coffee areas, Cameron Highlands, for instance, being free, and every endeavour should be made to prevent its introduction into these areas.

A General Description of the Stages.

THE BEETLE. (Figs. 4 and 6).

The beetle in appearance is somewhat shining and in colour dark brownish black to black with antennae and legs brown. Female, length about 1.58 mm. and breadth 0.77 mm.; male, length 0.99 mm. and breadth 0.53 mm. The body is cylindrical and uniformally covered with pubescence. The head is rounded and concealed from above by the pronotum. The antennae are about 0.53 mm. in length, the scape (the basal joint) about equal in length to the funiculus and the club together. The pronotum prominent, about half the length of the elytra and covered with small tubercles, which anteriorly are larger and more numerous. The margins of the elytra are parallel. They have their apices rounded and generally cover the pygidium. Sub-circular discs line the nine depressed rows on each elytron and short, broad, feathery scale-like hairs are placed on the shiny longitudinal elevations between these rows. The tibiae are toothed, the

STEPHANODERES HAMPEI Ferr.

EXPLANATION OF PLATE.

1. Eggs. 2. The Grub. 3. The Pupa.

4. The Female and 6. The Male beetle.

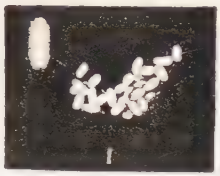
5. An Antenna.

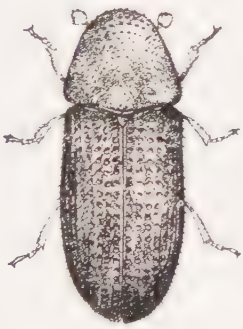
7. A Part of Wing Cover.

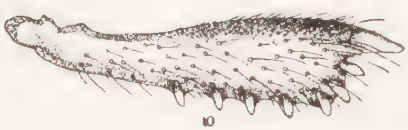
8. The Male and 9. The Female Wing.

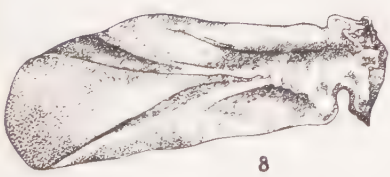
10. The Tibia of first, 11. of second and 12. of third pair of legs of the beetle, showing the arrangement of the teeth.

(All much enlarged).









tibia of the first pair of legs generally with six (sometimes seven), of the second pair five and of the third four teeth, in addition to the prominent apical tooth. Four segments of the abdomen are visible ventrally of which the first is equal in length to the second and third together.

The male is readily separated from the female by its small size : other minor differences in the sexes occur.

The Egg. (Fig 1.)

The egg is milky white, somewhat shining, elongate elliptical, rounded at both ends, slightly constricted in the middle, about 0.59 mm. in length and 0.28 mm. in breadth.

The Larva. (Fig 2.)

The young larva on emergence from the egg is about 0.84 mm. in length and anteriorly 0.25 in breadth, narrowing posteriorly. It is white, translucent with the head pale brown, mandibles brown and without legs. Its body is conspicuously clothed with white fine hairs. The full-grown larva is markedly curved, has shorter hairs than the young larva and is about 2.10 mm. in length and 0.80 mm. in breadth.

The Pupa. (Fig 3.)

The pupa is white, about 1.9 mm. in length and 0.74 mm. in breadth. Its head is completely concealed beneath the pronotum. About ten projections, each with a white hair, arm the margin of the pronotum. The anal segment has two inconspicuous whitish transparent projections. The wing covers extend ventrally to about 0.40 mm. from the termination of the abdomen.

Economic Importance.

The beetle for the most part bores into the green berry for feeding and into the ripe berry for breeding purposes. Slightly bored green berries, in close proximity to each other, are frequently observed without a beetle, indicating that they have all been bored by the same beetle, which has left one and migrated to another berry. By this method of attack, the bored unripe berries are exposed to fungoid enemies, resulting in the formation of black berries which fail to reach maturity. Such berries generally drop but frequently large numbers remain on the bushes. A considerable reduction of crop is occasioned in this manner, as is demonstrated by the following. Six bushes, from which bored green and ripe berries were collected weekly from the time of flowering to the harvesting of the ripe berry, supplied the following figures :—

Bored green berries	...	2085
Bored ripe berries	...	337
Unbored ripe berries	...	2236

In order to ascertain the reduction in the yield of beans over an area with fifty per cent. of the ripe berries bored, a collection of 500 unbored and 500

bored ripe berries from the same coffee bushes was examined. The unbored berries weighed 472.5 grams and the bored berries 468 grams—a difference of only 4.5 grams. From the unbored berries 938,* and from the bored berries only 453 sound beans were obtained. If the figure 938 be considered as representing the normal number of beans which are generally obtained from 500 unbored ripe berries, the reduction in crop in an area with a fifty per cent. of berry infestation would be in the region of twenty six per cent. In this percentage, the loss due to the damage of green berries, which is at times very high, is not included; if this were considered, the reduction in moderately infested areas would probably be in the neighbourhood of fifty per cent. In addition to this reduction in yield, the cost of harvesting and of treating worthless berries should not be overlooked.

It will be seen, therefore, that an estate with an infestation of fifty per cent. of ripe berries would suffer a direct loss in beans of twenty six per cent., but, where the regular collection of bored green, ripe and fallen berries is not carried out and the treatment of berries neglected, a higher percentage of bored ripe berries may frequently result.

Some Observations on the Life Cycle and Habits of the Beetle.

The female beetle bores into the coffee berry generally through the nipple, occasionally through the side and rarely near its attachment to the stalk. One entrance hole through the nipple is generally seen, but sometimes two or three are evident. The green berry is favoured for feeding and the ripe berry for breeding purposes. The degree of hardness of the bean determines the beetle's preference for egg-laying, the riper the berry, the more it is favoured for this purpose. The female beetle has been found in Malaya to live without food for 81 days and with food for 96 days. Friedrichs records that a female may live for 119 days and Leefmans for 123 days (4 months). The period of life of the female has an important bearing on the subject of control and will be considered later.

During the examination of berries of different ages, *when all green bored and black berries were removed,* no male beetles were obtained from bored green berries when collected weekly, fortnightly, three weekly and four weekly or from ripe berries collected weekly, fortnightly and three weekly or from black berries on the bush collected every three weeks. They were only recorded from ripe berries collected monthly, from black berries on the bush, where the collection had been extended to more than three weeks, and from fallen black berries on the ground. *When the green and black bored berries were not removed,* male beetles as well as male pupae were obtained from ripe berries collected weekly. Female beetles, on the other hand, are always numerous on

* In connection with this figure sixty two beans failed to develop. There may be several causes responsible for this reduction, but the thrips, *Haplothrips* sp., in the coffee flowers is probably one of the responsible agents for this degeneration, either directly by puncturing or indirectly by introducing a pathogenetic organism.

the coffee bushes and within berries of almost any age.

Whilst male beetles have only very rarely been observed to leave a berry, and then apparently when they are about to die, individual females emerge from a berry and fly at any time during the day, but in their largest numbers between two and five, reaching their maximum, however, between three thirty and four thirty in the afternoon. These observations suggest that male beetles neither leave the berry nor fly.

In an experiment, which consisted in encircling the trunks of coffee bushes with sticky bands, no males were seen either below, in or above these bands. On the other hand, females were collected below, in and above such bands. This result indicates that males do not reach the bushes either by flying or walking or descend to the ground by way of the stem. The wings of the female are fringed and comparatively large, being about 2.2 mm. in length; those of the males are not fringed and are much reduced,* being about 0.34 mm. in length, and, although the male beetle is much smaller than the female, the wings in the male do not appear to be sufficiently large for sustained flight. Again, if the male beetle is roughly handled or laid on its back, it has rarely been observed to spread its elytra.

Since healthy males have never been seen to leave the berry, the female beetles are either rendered fertile within the berry, in which they have reached maturity, or, provided that no males are present within that berry, enter other berries for the purposes of finding a male. That the female migrates from a berry, either on the ground or on a bush, to other berries has been confirmed on many occasions.

The variation in the proportion of the sexes is significant. In a collection of 744 beetles from ripe berries, 731 were females and only 13 were males. This proportion of females is high and is explained by the fact that males do not migrate from one berry to another. A collection of 200 black berries from the ground yielded 635 beetles, of which 576 were females and 59 were males. This proportion of females to males is low, and suggests that some females may have left these berries before they were collected. In weekly collections of 513 ripe berries from bushes, from which the green bored and black berries were not removed, 577 beetles were obtained, of which only 3 were recently emerged beetles. From these same berries, 296 pupae were collected, of which 273 were females and 23 were males. This result shows that male to female pupae bear a relationship of one to thirteen and may be considered to represent closely the proportion of the sexes of the beetle.

Parthenogenesis, *i.e.* reproduction without the intervention of a male, does not occur. The female, if isolated immediately on its emergence from the pupa, has never been observed to lay eggs, this act only occurring after the introduction of a male. Female beetles, which are removed from berries con-

* Occasionally very small beetles resembling males in size have been seen flying but, on examination, the wings have been found to be large and fringed, resembling those of the females.

taining eggs, will continue to lay eggs without the presence of a male beetle, indicating that they only require to be once fertilised. Females may lay eggs from four to fourteen days after emergence from the pupa so that, in order to reduce to a minimum the possibility of recently emerged females leaving berries and entering others for egg laying, weekly collections of berries should be conducted. Throughout the period of the life of the female, egg laying is more or less continuous. She rarely lays more than sixteen eggs at a time and frequently several days pass without eggs being deposited. The maximum number of eggs laid by an individual female has been found to be sixty. The eggs hatch in about 5—7 days, generally 6 days, into curved and legless grubs. They feed upon the bean and become full-grown in about 12—20 days, the general average being 17 days. Many individual grubs have been successfully reared to pupae without the presence of the beetle. The grub remains quiescent for a period of about two days before transforming to pupa. The pupa is found within the coffee bean and the duration of this stage is from 4—7, with an average of 5 days. A coffee berry may provide sufficient nutriment for at least 104 representatives of this beetle, since, in one fallen berry, forty four grubs, thirty six pupae and twenty four beetles were counted. It is possible too, that female beetles may have left this berry and migrated to other berries, either on the ground or on the bush. The maximum number of 99 beetles, 90 females and 9 males, was found in a black berry on the ground : this berry contained no other stages of this beetle. In addition to other stages, the maximum number of grubs found in any one berry was 70.

The Life Cycle may be summarised thus :—

		Days.	Average number of days.
Egg to Grub	...	5 — 7	6
Grub to Pupa	...	12 — 20	17
Pupa to Beetle	...	4 — 7	5
		21 — 34	28

The minimum number of days for the complete life cycle is therefore 21 with a maximum of 34, and an average of 28 days.

The Preference for Coffee Berries and Varieties.

The susceptibility of a coffee berry to attack depends almost entirely on its age and its variety.

1. The Age of the Berry.

In order to ascertain the age, *i.e.* the stage of the development of the berry when it is most susceptible to attack, several collections of berries in different stages of development of the Robusta variety were examined. The results on a 100 berry basis are tabulated below and are generally applicable to other coffee varieties.

	Eggs.	Grubs.	Pupae.	Beetles.	Total.
Bored green berries ...	19	3	0	53	75
Bored ripening berries ...	278	58	1	84	421
Bored ripe berries ...	495	329	49	95	968
Bored black berries on the bush ...	272	418	67	107	864
Bored black berries on the ground ...	14	42	20	318	394

The time from the flowering of the Robusta variety until the berry is ripe, when it measures about twelve mm. across its greater diameter, is from about eight to nine months. Very young green berries are rarely attacked and the damage to berries from about four to six months is limited to the feeding of the beetle. Berries older than six to seven months, *i.e.* when the greater diameter is from about seven to ten mm., may contain in addition eggs and grubs, their numbers increasing according to the degree of hardness, *i.e.* the age of the bean.

The ripening berries are more heavily attacked than green berries of six to seven months old but less than ripe berries of about eight to nine months old. The small undeveloped black berries on the bush have occasionally been found harbouring beetles, which have generally been dead, but the larger black, and, therefore, older berries on the bush, generally contain all stages of the insect. The figures above show that bored ripe berries are most heavily infested, and, whilst the fallen black berries contained the least number of eggs, they harboured most beetles, and before these berries were collected some beetles had probably left to continue their work of destruction. The number of bored green berries of all ages examined was 1526 and, whilst containing only 286 eggs and 50 grubs, 809 beetles were recorded, thus demonstrating that the beetles favour the green berry for feeding purposes.

The selective preference for berries by the beetle is interesting, but the most important consideration is that the black unremunerative berries on the bush and on the ground harbour and provide sufficient nutriment for the development of large numbers of the beetle. It is, therefore, most important that all black berries whether on the bush or on the ground be collected and disposed of. This aspect of the question will be discussed under control, but the importance of disposing of black berries may still further be emphasised by recording that one black Robusta berry collected from the ground was found to be harbouring 99 beetles—93 females and 6 males. (This figure is not included in the above numbers).

2. Variety.

A considerable variation in the number of bored berries from different coffee bushes of the same variety occurs. In illustration of this, collections of ripe berries were made on the same day from two bushes, growing next to each other, of the Robusta variety. From the one, 211 unbored and 59 bored and

from the other, 8 unbored and 184 bored ripe berries were collected. At the time of the collection, the berries from the bush with the higher infestation were observed to be softer and their skin more shining. It seems probable that the variation in the texture of the pulp is a factor governing the intensity of attack to the berry.

In an area supporting several varieties of coffee, growing in close proximity to each other, two to three hundred ripe berries of each variety were examined† regularly every week in order to ascertain the variety most subject to attack.

The detailed analysis of the unbored and bored berries from these collections need not be given; the result on a 1,000 berry basis was as follows :—

		Unbored.	Bored.
Abeocuta	...	993	7
Excelsa	...	986	14
Liberica	...	953	47
Robusta	...	841	159
Canephora	...	711	289
Uganda	...	635	365
Quillou	...	230	770

Bunting and Milsum* observe that Abeocuta, Excelsa and Liberica are varieties of the Liberian type of coffee and Robusta, Canephora, Uganda and Quillou of the Robusta type and give the proportion of fresh berry to dry bean as follows :—

Liberian Type.		Robusta Type.	
Liberica	10 to 1.	Robusta	4.5 to 1.
Excelsa	7.5 to 1.	Canephora	4.5 to 1.
‡Abeocuta	7 to 1.	Uganda	4 to 1.
		Quillou	4 to 1.

It is interesting to observe that the berries, *viz* :—the Liberian varieties, with a larger proportion of pulp are less subject to attack. The beetle generally enters the berry through the nipple, very occasionally holes have been observed in the sides of the berry, and, although there would appear to be good grounds for stating that this beetle prefers berries with the smallest proportion of pulp, the ease with which the beetle can penetrate the nipple may determine its preference, since the nipple of the Robusta varieties appears to be softer than that of the Liberian varieties. The susceptibility of the varieties of Robusta coffee may be due to odoriferous substances in the skin but, whilst this may be true, the proportion of the pulp or the degree of hardness of the nipple cannot be wholly ignored. Liberian coffee is considered to be most suited to the peaty soil of the coastal district, Robusta to inland virgin land and Arabian§ coffee for cultivation

† Mr. J. L. Greig, Assistant Agriculturist, kindly forwarded the writer each week a consignment of berries of each variety for examination.

* "The Cultivation of Coffee in Malaya", *Malayan Agricultural Journal*, Vol. XVIII. No. 10, October, 1930.

‡ The writer is responsible for this figure.

§ The writer has had no experience with this beetle in its relationship to Arabian coffee.

in the hills. The suitability of the soil to the variety of coffee must of necessity be considered, but, so far as *Stephanoderes* is concerned, preference should undoubtedly be given to those which are less subject to attack, *viz* :—the Liberian varieties, Excelsa, Liberica and Abeocuta.

Enemies.

No parasitic or predaceous insects have been recorded in Malaya. An entomophagous fungus (*Botrytis stephanoderis* Bally), parasitic on the beetle, is generally distributed but is not effective in reducing its numbers. Beetles which have been killed by this fungus are revealed by a whitish looking deposit at the entrance hole at the nipple of the berry and are frequently associated with the green berry.

In Java, the predaceous bug, *Dindymus rubiginosus* F., has been recorded as an enemy of the beetle but apparently is of little importance. Swallows have also been observed catching the beetles.

Two hymenopterous parasites, *viz.* the Bethylid, *Prorops nasuta* Waterston and the Braconid, *Heterospilus coffeicola* Schmeid, indigenous to Uganda, have been imported into Java and the former into Brazil. *P. nasuta* became established in Java, but Dr. Leefmans in correspondence in 1929 informed the writer that it had proved of little importance with regard to the suppression of the pest.

The Control.

This beetle is not present in all coffee areas in Malaya and precautions should, therefore, be taken to prevent its introduction into those areas which are free and into those areas which are intended for coffee, and, since it has not been found breeding in any other seed, attention need only be directed to the coffee bean, and more especially, if it is intended for planting purposes. In opening up new areas, it is advisable to ascertain if isolated coffee bushes occur in the neighbourhood and, if infected, to endeavour to have them destroyed or to keep them free from berries for some six months, since after that period no beetles should exist, and to have all fallen berries collected.

In order that the destruction of infested bushes or the collection of berries on the bush and on the ground may be effectively carried out, intending cultivators may consider it to be desirable to pay the owners compensation for loss of crop.

I—The Treatment of the Bean for Planting and Commercial Purposes.

All seed intended for planting whether for "new" or established areas should be fumigated.

Hydrocyanic acid gas and carbon bisulphide have proved successful fumigants in rendering the seed free from beetles, but are not recommended, owing to the care required in using these substances, the difficulty in procuring them, their liability to reduce the germination of the seed and the simplicity and effectiveness of fumigation with turpentine.

Dr. H. Begemann of the Malang Experiment Station was the first to advocate

the fumigation of coffee seed with turpentine and Dr. S. Leefmans very kindly sent a translation of the description of this method to the writer in March, 1929. In a recent paper, Dr. Begemann has described * the fumigation of seed intended for planting purposes with turpentine. This method has been practised by this Department and has proved to be eminently successful in killing all stages of this beetle.

A sample of infected seed, which had been fumigated with turpentine for three days, was examined with the following satisfactory result.

Number of beans bored by *Stephanoderes*	...	108.
Number of collapsed eggs	...	70.
Number of dead grubs	...	112.
Number of dead pupae	...	45.
Number of dead beetles	...	58.

No live forms were observed in any of these beans.

Germinating tests† have been made with 250 seeds mixed with charocal before and after fumigation with turpentine.

Of the seeds mixed with charcoal before fumigation 135 (54 per cent.) and after fumigation 177 (71 per cent.) germinated. This result demonstrates the importance of mixing the seed with charcoal after fumigation.

The method is briefly as follows :—

A kerosene tin is fitted with 8 trays made of a 8 mm. mesh, their upturned edges being about 4 cm. A cloth which has been soaked with turpentine is then placed in each tray and on top of the cloth a layer of coffee seed about 4 cm. in depth is placed. The kerosene tin is closed with a tightly fitting lid which may be made more air-tight by surrounding the rim of the lid by a rubber band of about 4 cm. in width.

The seed is fumigated for a period of three days, after which time, all stages of the beetle will have been killed. The seed is afterwards aerated in another kerosene tin, fitted with similarly sized trays, but with its sides replaced by fine gauze to prevent the entrance of the beetle and to allow free circulation of air. For larger quantities of seeds, drums, barrels, boxes or similar utensils may be used. The seeds after being fumigated are mixed with fine charcoal.

The introduction of this beetle through infested coffee beans prepared for consumption is possible, but the process of fermentation and of drying the coffee bean is generally fatal to all stages of this beetle. It has, however, been reported in Europe in prepared coffee beans intended for consumption, and found in Malaya in beans after the operation of pulping, and in beans, admittedly in small numbers, ready for the market. In order to eliminate the possible danger of its spread in market coffee, and also to assist in its control, all coffee berries, prior to pulping, should be immersed in boiling (not merely hot) water, small

* Archief voor de Koffiecultuur in Nederlandsch—Indie, IV, No. 2, October, 1930.
† These tests were made by Mr. J. L. Greig, Assistant Agriculturist.

quantities for 1½ mins. and large quantities (sack full) for a period of 3 mins.,* and then afterwards completely submerged for a period of four days. Submersion of the berries is not sufficient, not only do the beetles leave the berries during this treatment but all stages of the beetle have been found in berries which have only received this treatment, the beetles escaping immediately the beans are dried. It has been stated that, after immersing the berries in boiling water, the quality of the bean is impaired. The writer considers this to be an erroneous impression. He is well aware that bored beans which have been treated become discoloured, but, in any case, such beans have generally been so heavily attacked by the beetle that they are almost worthless.

II—The Treatment in the Field.

The writer is of the opinion that no reduction in the number of this beetle, and, therefore, no increase in the yield of beans, will result, unless black berries, on the bush and ground, and bored green and ripe berries, are regularly and frequently collected and treated.

It has been suggested in conversation that this beetle, although causing a considerable reduction at first in the yield of coffee beans, eventually diminishes in numbers and, as a result, is responsible for less injury. The writer considers, if less berries are bored, that this reduction has been brought about by instituting a more regular and frequent collection of the berries. A coffee area, where berries are occasionally collected, that is to say an area more or less in an abandoned state, has been under observation for more than a year, and during that period berry infestation of about ninety per cent has been maintained.

In this infested area, experiments in weekly, fortnightly, three weekly and monthly collections have been in progress. The opportunity to confirm the results of these experiments in different areas has not been offered, but they show, even in this heavily infested area, a considerable reduction in bored ripe berries of individual bushes. With the exception of the control, all bored green and black berries of the experimental bushes were collected at the same time as the ripe berries. No black or fallen berries were gathered from the ground. The figures for ripe berries are placed on a percentage basis and are as follows:—

Period of collection		Per cent. Bored ripe berries	Per cent. Unbored ripe berries
Weekly	...	10	90
Two weekly	...	21	79
Three weekly	...	24	76
Four weekly	...	34	66
Control; weekly, ripe berries only	...	89	11

If, however, the number of bored black and green berries which were re-

* Mr. J. L. Greig, Assistant Agriculturist, immersed a sack full of coffee berries in boiling water for three minutes and forwarded a quantity to the writer for examination. Only dead forms were seen.

moved from these same bushes, is included, the ripe unbored berries collected on a percentage basis are as follows :—

Weekly	...	58
Two weekly	...	41
Three weekly	...	* 43
Four weekly	...	* 43
Control—weekly, ripe berries only	...	11

Although this result is not so significant, it demonstrates the advantage of removing the bored green and black berries, since, even in the weekly collections, where the fall of berries would be small during a week, an increase of forty seven per cent. in the harvest of ripe berries is obtained.

In order to illustrate still further the importance of weekly collections of ripe, bored green berries (and black if any,) from the bush, only the ripe berries from two bushes in this heavily infested area were collected over a period of eleven weeks, and, after obtaining the percentage infestation of ripe berries, the bored green and black berries, if any, in addition to the ripe berries over a period of forty eight weeks were removed.

The result is tabulated below :—

		Ripe unbored berries collected	Ripe bored berries collected
Bush 13	Ripe berries only removed	19	607
	All ripe, black and green berries removed	1893	86
Bush 17	Ripe berries only removed	15	348
	All ripe, black and green berries removed	426	74

By carrying out the collection of all bored green berries (and black, if any) the proportion of unbored ripe to bored berries, in Bush 13, rose from 1 to 32 to 22 unbored to 1 bored and, in Bush 17, from 1 to 23 to 6 unbored to 1 bored.

The above result is of definite economic value as illustrating the necessity of the frequent collection, not only of the ripe bored and ripe unbored berries, but of the bored green and black berries.

The harvest of ripe unbored berries from these two bushes, prior to the weekly collection of bored green berries, was about 3 per cent., but after the collection of these berries, the harvest of ripe unbored berries rose to 93 per cent. In the case of Bush 13, 695 and Bush 17, 671 bored green berries were removed and if these figures are considered, the harvest of ripe unbored berries is reduced to 60 per cent., but this is a significant increase of 57 per cent. in ripe unbored berries over the 3 per cent. when the green bored and black berries were not removed.

* It is possible that, during the intervals of three and four weeks, a considerable number of bored berries dropped to the ground. This would account for the increase in the number of unbored ripe berries collected.

Some of the collections of berries from the above experiments were examined, from which the following figures relating to the maximum number of living stages in an individual berry were obtained.

Nature of Berry	Collected at intervals of	Beetles		Eggs	Grubs	Pupae
		Male	Females			
Ripe	one week	—	2	36	—	—
,,	two weeks	—	1	4	15	—
,,	three weeks	—	1	14	22	—
,,	four weeks	—	26	1	22	14
Black from ground		—	24	0	44	36
Black on twigs		—	15	0	70	4

The above figures must not be taken to mean that grubs are never found in berries which are collected weekly, that no pupae are present in berries collected every three weeks and that male beetles are not seen in ripe berries collected every four weeks or in black berries on the bush or the ground. The maximum number, 104, was obtained from a single fallen black berry: it has already been recorded that ninety nine beetles were collected from one fallen berry,—no other stage being observed.

The number of forms * which inflict immediate damage to the bean are two in the weekly, sixteen in the two weekly, twenty three in the three weekly, forty eight in the four weekly, sixty eight in the fallen black and eighty five in the black berries on the twigs.

The following relates to the maximum number of any living stage found in green, ripe and black berries on the bush and on the ground.

Number of berry	Collected at intervals of	Beetle		Eggs	Grubs	Pupae	Total
		Male	Females				
Green	One week	—	3	2	—	—	5
,,	Two weeks	—	1	8	—	—	9
,,	Three weeks	—	2	8	—	—	10
,,	Four weeks	—	2	19	15	—	36
Ripe	One week	—	2	36	17	—	55
,,	Two weeks	—	2	21	18	—	41
,,	Three weeks	—	8	25	25	14	72
,,	Four weeks	4	26	24	38	21	113
Black on the bush		4	45	28	70	30	217
Black from ground		9	90	13	44	36	195

* Forms = Grubs and Beetles.

The greatest number of eggs found in any one berry was 36, of grubs 70, of pupae 36, of female beetles 90 and of male beetles 9.

The above figures also show that all stages of this beetle, which include the male beetle, are found in maximum numbers in ripe berries collected at an interval of four weeks, and in black berries on the bush and on the ground, and demonstrate (1) the importance of frequent collection of ripe and black berries and (2) of weekly collections, especially if consideration is given to the increase in numbers, *i.e.* the greater destruction of beans, when the interval between collections is extended to more than one week.

The importance of the weekly collection of bored green berries is also demonstrated by the following figures :—

Collected at an interval of	Number of berries examined	Number of beetles	Number of eggs	Number of grubs	Per cent of berries containing beetles
One week	385	177	1	—	46
Two weeks	137	80	12	—	58
Three weeks	267	157	12	—	58
Four weeks	353	218	260	50	62

A considerable increase in beetles, eggs and grubs occurs if the collection of green bored berries is not more frequent than every four weeks.

The consideration of the above results clearly emphasises the importance of the weekly collection of all bored green, ripe and black berries on the bush and on the ground, and every endeavour to control this insect should be made by inaugurating a weekly collection of the above enumerated berries.

The beetle lives for about four months and its minimum life cycle is 21 days, so that, on theoretical grounds, if, throughout an area, all bored green, black from the ground and the bush, and all ripe berries could be collected on the same day and the collection of all such berries continued at an interval of less than three weeks during a period of four months, no individuals would remain. On a small area, this procedure may be possible, but, on a large area, the aim should be to clear it of all such berries in the shortest interval of time and to institute a regular weekly collection. If such a policy were adopted, the reduction in bored ripe berries would undoubtedly soon occur. In this connection, the harvesting of the just under ripe berries, in which the stages of the beetle are less numerous than the fully ripe berries, should be considered. It should be remembered that the longer the berries remain on the bushes, the greater the number of all stages of this beetle within them and the greater the destruction of the beans.

The collection of fallen berries is of paramount importance, and, in order to facilitate this and to make it as complete as possible, the growth of weeds

and cover crops should not be encouraged, since they will militate against the sucessful control of this insect.

The importance of weekly collections of all ripe, bored green and black berries on the bush and on the ground has been stressed. The aim is to reduce this beetle to such small numbers that it ceases to be a pest, and any measure which will assist in this direction should be practised.

The coffee berry is either collected in baskets or bags. Baskets should not be used, since the beetles are able to escape from the berries through the interstices. Bags made of closely woven material should be substituted for baskets. They should not be completely filled as the over-lap will form a flap, thus closing the bag and preventing the escape of the beetle. Separate bags may be employed for collecting the green bored and black berries from the ground and bush. The bags containing the berries should be immersed in boiling water, (v. page 9), if possible in the field, thereby killing the beetle and automatically reducing its numbers in the vicinity of the factory. This procedure, however, may be considered to be impracticable in the field, but it is, nevertheless, essential for the control of this insect that all berries, whether treated in the field or near the factory, should be immersed in boiling water before pulping is begun. If this operation is delayed, the berries should be placed in receptacles to prevent the escape of the beetle. This precaution should be carried out with due regard to the fact that the beetle, in maximum numbers, leaves the berry between three thirty and four thirty in the afternoon, and, during these hours, the less the berries are disturbed the better.

In conjunction with the above, the factory and its vicinity should be kept clean and all refuse burnt. No residue in which the beetle may breed should remain in the store, within the factory or in its vicinity.

In Malaya, the climate is generally similar to that of Sumatra and, in both countries, coffee berries are produced continuously throughout the year. There is no definitely marked coffee season. In Java, a dry season, when few berries are produced, occurs and advantage is taken during this time to institute a "dead" season. During this season, no berries are allowed to form and all possible breeding places, such as fallen berries, receive attention. By this procedure, this beetle in Java is not, by any means, so important a pest as in Sumatra and Malaya. The institution of a "dead" season in Malaya implies a considerable reduction of crop, with the ultimate risk of the area becoming re-infected, and should only be recommended for isolated coffee areas, where there is no risk of re-infection, or where owners of cultivated areas in the vicinity of each other agree to co-operate and supervise efficiently the collection and treatment of all berries and the prevention of the formation of berries. A "dead" season should be for a period of six months and, during that time, no berries should be allowed to form and all berries on the bush and ground must be collected and treated. One undiscovered berry may become the focus for a general increase of this insect and the aim of eliminating this beetle by starvation will have been frustrated. Mr. W. H. Barnes, Agricultural Field Officer, Negri Sembilan, who instituted

a "dead" season of six months in an isolated area of infested coffee, informed the writer that he examined the area after eighteen months and, although the trees were fruiting heavily and ripe coffee was plentiful, he was unable to find a single case of a bored coffee berry.

Acknowledgments.

I should like to express my very grateful thanks to Dr. S. Leefmans, Head of the Institute for Plant Diseases, Java, for his ready assistance, and for the information concerning this beetle, which he willingly placed at my disposal, in February, 1929.

I also wish to record my appreciation of the work of Che Mohamed Yusope, Malay Agricultural Assistant, Grade I, and Che Abu Hassan, Malay Agricultural Assistant, Grade II, who have been most helpful in recording the data on which this paper is largely based.

Summary.

1. *Stephanoderes hampei* is an introduction into Malaya and was first discovered in Selangor in January, 1929.
2. A general description of the stages of the beetle is given.
3. With a berry infestation of 50 per cent., a direct reduction in beans of 26 per cent. results.
4. The beetle may live for four months. The proportion of females to males is about 13 to 1. Only the female beetle flies. It is rendered fertile within the berry in which it completes its cycle or migrates to other berries for this purpose.
5. Green berries are favoured for feeding. The ripe and black unremunerative berries on the bush and on the ground are heavily infested by this beetle and are favoured for breeding purposes.
6. The Liberian varieties of coffee being less subject to attack than the Robusta varieties should, if conditions are favourable, be planted.
7. All beans for planting should be fumigated with turpentine. The method is described. Coffee berries for commercial purposes should be immersed in boiling water prior to pulping.
8. The decrease in the number of bored ripe berries resulting from the weekly collection of all bored ripe and green berries and black berries on the bush and ground is demonstrated.
9. A 'dead' season of six months, when no berries are allowed to form and when all black berries on the ground and bush are collected, is only recommended for isolated coffee areas and where owners are willing to co-operate and supervise efficiently the treatment and collection of all berries.

BLEACHING OF PALM OIL.

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Introductory.

In view of the increasing Malayan production of palm oil and the recently imposed duties on imported oils and fats for edible purposes, several enquiries have been received as to the possibility of the introduction of palm oil to the local market having regard both to the high quality of the estate product and its present relatively low price.

Although, at present, palm oil finds its principal applications in soap-making and tin-plating, the oil is also employed to a certain extent in the manufacture of edible products and it seems reasonably certain that, as larger and more regular supplies of this high grade oil become available, an increasing use for edible purposes will result.

While estate palm oil is of high quality and is therefore suitable for edible purposes, the marked red colour of the oil is a disadvantage and recourse must therefore be had to bleaching.

Although, as will be seen later, bleaching constitutes only one stage in the complete refining process of an oil for edible purposes, it is the most important stage as far as local consumption is concerned, since it is well-known that with certain classes of the community the intense colour of the crude oil is one of the objections to its adoption, for example as a cooking oil. Further, it must be remembered that the other local oils, notably coconut oil and groundnut oil, with which palm oil would compete and which are not subjected to any refining process, are only slightly coloured.

It was felt, therefore, that if some simple means of bleaching palm oil could be found, the local utilisation of the oil on a wider scale might be envisaged; the oil at present being used locally only to a very small extent in the manufacture of soap, for which purpose also it is preferable to use a bleached oil.

While the present paper deals primarily with experiments carried out regarding a simple method of bleaching the oil to a sufficient extent to enable it to meet local requirements, it is also proposed to refer briefly to the properties of palm oil and to the question of the complete refining of an oil for edible purposes.

Properties of Palm Oil.

It is well-known that the hardness of palm oil varies with the acidity; an oil of low acidity, such as that produced by estates forming, when freshly prepared, a thin, pasty, deep orange-yellow mass. On standing at the ordinary temperature, the mass will separate gradually into two layers, a deep red liquid fraction superimposed on a solid, yellow coloured fraction.

It is possible to effect separation by filtration through paper or canvas, as a result of which it will be found that the two fractions are present in approximately equal proportions by volume.

From a chemical point of view, palm oil is classified as a vegetable fat, some of the physical and chemical constants of estate oil being as follows :—

Oil		
Specific gravity at 99.5°C (water at 15°C = 1)	... 0.860 —	0.861
Saponfication value	... 201.0 —	202.5
Iodine value (Wijs)	... 50.3 —	52.7
Acidity (palmitic acid per cent.)	... 4.2 —	5.8
Fatty Acids		
Solidifying point (Titer value)	... 44.9 —	46.3°C.
Mean molecular weight	... 270 —	271
Iodine value (Wijs)	... 52.5 —	54.2

With regard to the range of acidity quoted, it may be pointed out that the figures are now considered slightly high for an estate product. The particular samples of oil were, however, obtained from estates on which the fruit was separated in the field, the loose fruit being brought into the factory for treatment. On account of the inevitable bruising associated with the handling of the loose fruit, the acidity of the resultant oil is always slightly greater than if the bunches are first sterilised before separation of the fruit. Since the process of bunch sterilisation is gradually being adopted, it should soon be possible for any estate under normal working conditions to maintain the acidity of its oil between 3 and 4 per cent., calculated as palmitic acid.

According to Drummond and Coward (1) the colour of palm oil is due to a mixture of carotene and xanthophyll in the proportion of 3 parts of the former to 1 of the latter. It may be mentioned that carotene is a hydrocarbon (a chemical compound containing only carbon and hydrogen) having the formula $C_{40}H_{56}$, while xanthophyll has the formula $C_{40}H_{56}O_2$, that is, it contains the same number of atoms of carbon and hydrogen, and in addition two atoms of oxygen.

The presence of these fat-soluble pigments is interesting from the point of view of the nutritive value of the oil, experiments (2) having shown that, while the majority of oil seeds employed for the preparation of edible oils and fats contain relatively very small amounts of vitamin A, a fat-soluble vitamin, the activity of palm oil in this respect is remarkably high.

As is well-known vitamin A is considered to be associated with bodily growth

and vigour and there is reason to suppose that the absence of this vitamin in a diet lowers resistance to infection, more particularly in the case of diseases of the pulmonary tract.

It would appear, therefore, as if there is some relation between vitamin A and the fat-soluble pigments present in palm oil, so that from a purely nutritive point of view bleaching is not advisable owing to the destruction of the pigments during the process.

The questions of the nutritive value of palm oil and of an adequate supply of vitamin A in a diet are, however, outside the scope of this paper, reference being made to these questions purely from the point of view of information regarding the properties of the constituent chemical compounds to which palm oil owes its colour.

General Description of Methods for Bleaching Palm Oil.

The principal methods employed for bleaching palm oil on a large scale can be classified as follows (*a*) adsorption of colour by bleaching earth (*b*) chemical bleaching, involving oxidation or reduction (*c*) air-bleaching with or without the addition of a catalyst.

The above classification is by no means exhaustive; there are other means available, for example, palm oil can be bleached satisfactorily by exposing the oil in a thin layer to the action of sunlight. Such a method is scarcely practicable on a large scale, even in Malaya, on account of the absence of a prolonged dry season.

Further, as will be seen later, bleaching can be effected by heating the oil to a temperature of approximately 240°C and it is understood that such a method has been proposed for adoption on a commercial scale, the treatment being carried out *in vacuo*.

With regard to the three methods mentioned above, bleaching of the oil with fuller's earth is the method chiefly used in Europe, especially when a high-grade product is required, since in the preparation of an edible oil it is essential to effect the necessary purification under conditions in which the quality of the oil will be affected as little as possible. A physical method of bleaching, using a substance such as fuller's earth, is therefore, to be preferred to one of the more drastic chemical methods to which reference will be made later.

Satisfactory bleaching with fuller's earth is a rather intricate process. It appears as if the best results can only be obtained if the oil is first activated by means of treatment with dilute acid prior to the addition of the bleaching agent. The oil and fuller's earth are heated *in vacuo* with constant agitation in order to ensure the maximum effect, the temperature being gradually raised to 100°C in order to expel excess of moisture. The oil is then cooled and filtered to remove the bleaching agent. The object of treatment in absence of air is to ensure the quality of the oil being affected as little as possible in view of the necessity of raising the temperature so as to effect the necessary bleaching.

A relatively large amount of palm oil, more especially oil used for soap manufacture, is still bleached by chemical means; for example, sodium dichromate and a mineral acid, hydrochloric acid or sulphuric acid, the bleaching action being accelerated by blowing air through the mixture, which is warmed to a temperature of approximately 40°—50°C. Subsequently, the oil must be washed with water two or three times in order to remove soluble salts and excess acid.

Palm oil can also be bleached by heating in a current of air with or without the addition of a catalyst* (3). Further, the amount of catalyst needed to produce the necessary effect is very small; as will be seen later, an amount of one-hundredth part per cent. by weight of the catalyst, calculated on the weight of oil, is sufficient to reduce the period of bleaching by approximately 75 per cent.

Although the usual method of air-bleaching is to blow or aspirate the air through the heated oil in the absence of a catalyst, a more rapid effect is likely to be produced by exposing the oil in as fine a state of division as possible to the action of the air. This can be accomplished by introducing the oil into the bleaching chamber in the form of a fine spray, the temperature being maintained by means of high-pressure steam.

Omitting, therefore, the methods of bleaching by means of fuller's earth and by the addition of chemical reagents as being too intricate for present adoption on a large scale, it was decided to restrict the experiments to the method of air-bleaching.

Air-Bleaching of Palm Oil.

In view of the necessity of making the process as simple as possible, some experiments were first carried out by merely heating the oil in an open vessel, with only occasional stirring.

It was found that a fairly satisfactory bleaching action could be effected by heating the oil to a temperature of approximately 240°C and maintaining that temperature for a period of approximately 5 minutes. When discussing the various methods of bleaching palm oil, reference was made to such a process, except that it was carried out *in vacuo,* under which conditions the quality of the oil would not be affected to the same extent as by allowing access of air.

When heated in air the oil developed a greyish tint, the coloration becoming slightly more marked on storage, while in addition, the odour became more pronounced. Such a process is, therefore, not to be recommended, since in addition to these defects, there is a difficulty of heating a large quantity of oil to such a relatively high temperature, which is approximately only 50° less than the flash-point of the oil, 290°C. The proximity of the temperature to which the oil is heated to the flash-point suggests the possibility of a slight decomposition effect as evidenced by the development of the greyish colouration.

By reducing the temperature to 150°C., at which temperature the quality of the oil would not be affected to the same extent, and aspirating or blowing

* A catalyst is a substance which allows a chemical reaction to proceed more rapidly, itself remaining unchanged on the completion of the reaction.

air through the oil at a rate of approximately one-hundredth part of its volume per second, it was found that a satisfactory bleach could be effected in approximately 3 hours.

Further experiments showed that, maintaining the same rate of air supply to the oil, the rate of bleaching was dependent on the temperature, the lower the temperature the longer the period necessary to effect a bleach; for example, at a temperature of 110°C. a period of even 7 hours was insufficient to bleach the oil completely.

A series of experiments carried out to determine whether the rate of bleaching was affected by the acidity of the oil resulted in the conclusion that, although the acidity of the oil was only 4 per cent. calculated as palmitic acid, the rate of bleaching was considerably retarded when neutral oil was used. This is an advantage since, if the object of the treatment is the production of a bleached neutral oil, it is possible to combine in one operation both the neutralisation of the free fatty acids and the washing of the oil to remove small quantities of certain soluble odoriferous compounds, possibly produced during bleaching. A previous series of experiments had shown the appearance and the odour of the bleached acid to be improved by washing with hot water, the improvement becoming still more marked if the washing was combined with a preliminary treatment with alkali to remove free fatty acids in addition.

The experiments on the catalytic bleaching of the oil were based on the investigation of Sastry (3) referred to previously, compounds of cobalt, nickel and manganese being used as catalysts. Probably on account of the differences in acidity, the results of the two investigations are not comparable, the oil with which Sastry carried out his experiments having an acidity of approximately 22.5 per cent., calculated as palmitic acid, while that used in the present series had an acidity of only 4 per cent., calculated on a similar basis.

The catalysts used were confined to the borates and resinates of the three metals mentioned above, the respective compounds themselves being prepared by double decomposition of a soluble salt of the particular metal; for example, cobalt sulphate, with the requisite amount of a solution of sodium borate (borax) or sodium resinate. In each case the precipitate was washed with water till free from soluble salts and dried.

As explained previously, only a very small proportion of catalyst was required, the amount necessary for effective bleaching being of the order of 0.01 per cent. by weight of that of the oil being bleached.

Further, as found by Sastry, the addition of a catalyst enables the bleaching action to proceed at a lower temperature; as will be seen later, effective bleaching with such a catalyst can be carried out at a temperature of approximately 90°C. This has an important bearing both on the quality of the oil and the machinery required. As regards the former, the lower the temperature at which the bleaching action can be effected the less the quality of the oil will be affected; while as regards the type of plant necessary, the fact that bleaching can be carried out below a temperature of 100°C would facilitate control of tempera-

ture, since steam can be used as the heating agent.

The results of a series of experiments in which the different catalysts were used are shown in the following table. In all cases the same quantity of oil was used and the amount of catalyst maintained at 0.01 per cent. of the weight of oil. Bleaching was also carried out at approximately 90°C., while as far as possible a uniform rate of aspiration of air through the heated oil was maintained in every case.

The periods of bleaching are only approximate, the colours of the various samples of the bleached product being compared merely from tubes of the oils cooled under similar conditions, using a sample tube of oil, fully bleached but without a catalyst, as a standard.

Catalyst.		Period of Bleaching hours.
Cobalt borate	...	2.5
Manganese borate	...	9
Nickel borate	...	12
Cobalt resinate	...	1.5
Manganese resinate	...	7
Nickel resinate	...	13

The results of the experiments show the superiority of the two cobalt compounds as catalysts, compared with those of manganese and nickel.

Although cobalt resinate is superior to cobalt borate as regards bleaching action the latter is to be preferred, since cobalt resinate is soluble in the oil, whereas the cobalt borate, being insoluble, can be removed from the bleached oil by filtration. No traces of cobalt could be found in the filtered oil bleached by cobalt borate.

Before discussing the application of the method of bleaching to local conditions attention might be drawn to another investigation that was carried out as regards bleaching both the liquid fraction and the solid fraction into which palm oil can be separated by filtration.

The object of this investigation was to demonstrate the possibility of bleaching the separate fractions, thereby being able to produce, if necessary, a liquid oil that would compare as regards colour with other oils used locally, for example, groundnut oil and a solid white fat of the consistency of other available fats.

It was found that the two fractions could be bleached as satisfactorily as the whole oil, a period of approximately 3 hours at 150°C. being required to effect a satisfactory bleach when air alone was aspirated through the heated oil, while using the same amount of cobalt borate as in experiments with the whole oil it was possible to carry out the bleaching in approximately 2 hours at 100°C.

Although the liquid fraction when first bleached is a clear pale-yellow oil it is found that after storage for two months a small amount of greyish-white solid is deposited. The deposit probably consists of solid glycerides, since they dissolve in the oil when the latter is warmed.

Local Application of Method of Air-Bleaching.

The results of the experiments with air-bleaching indicate the possibility of the production of a bleached palm oil of good quality without the installation of an expensive plant.

Although the quality of such a bleached oil could not be guaranteed to remain unchanged on prolonged storage on account of the insufficiency of the purification treatment, it is considered that such an oil might find an application, provided it could be used without delay.

The main plant required, which would not be expensive, would comprise a series of iron tanks, similar in design to those used for palm oil purification. Each tank should be fitted with an open steam pipe, an air injection pipe and a stirring gear for maintaining the oil in a state of agitation. If it is intended to use a catalyst, such as cobalt borate, it would be preferable to have a closed steam coil also fitted into the tank. With air alone this would be unnecessary, the tank being erected so that a fire could be lighted below. A mechanical blower would be necessary for the air supply.

The addition of a filter-press would be an advantage, especially in the event of catalytic bleaching, to ensure the removal of the whole of the catalyst and any matter in suspension.

In the event of the bleached oil being also neutralised, the question of the disposal of the alkaline sludge would arise. Unless this could be treated with excess mineral acid and the resultant acid oil, as it is termed, utilised for soap-making there would be a loss of oil. In general the loss in neutralising is approximately double the acidity; for example, if the acidity is 4 per cent., calculated as palmitic acid, then 100 parts of the crude oil will yield only 92 parts of the neutral oil.

Although the method of air-bleaching has been described as simple, the question of the necessity of careful control throughout the process cannot be too strongly emphasised, particularly when it is essential to maintain a standard product. Special attention would have to be paid to such points as period of bleaching, control of temperature, rate of air supply. For example, as regards the period of bleaching, laboratory experiments have shown that even though the temperature and the rate of air-supply may be maintained constant, there is an optimum period for heating the oil, after which the latter becomes slightly dull in appearance.

Since the bleaching of vegetable oils, which is only one branch of a highly specialised industry, vegetable oil refining, has been developed to such an extent that standardised bleached oils are now available in enormous quantities, it is essential to aim at a product of standard quality. The technique of oil bleaching is more complicated than that of oil production and it is doubtful whether, in the event of a demand arising for a bleached palm oil, the process could be recommended for general adoption on estates, unless the estates were sufficiently large to have separate oil refining sections under technical supervision.

Outline of Process for the Refining of Vegetable Oils.

Although the present paper deals primarily with the bleaching of palm oil, as indicated previously a brief reference will be made to the complete process for the refining of a vegetable oil to ensure an edible product of the highest grade.

Assuming that a good quality vegetable oil, such as estate palm oil, is available, and no preliminary treatment to remove sludge or mucilaginous matter is necessary, the process can be divided into three sections

(i) Bleaching the oil (Decolorisation)
(ii) Removal of acidity (Neutralisation)
(iii) Removal of odour and taste (Deodorisation).

Although, according to the above scheme, bleaching precedes neutralisation, the order of these operations is sometimes reversed, being dependent on the character of the oil. For example, in the case of a very dark coloured oil, such as cottonseed oil, in which a certain amount of decolorisation would be effected as a result of treatment with alkali, it would be preferable to neutralise first, carrying out the bleaching with the neutral oil.

There is no necessity to refer again to the question of bleaching except to repeat that in the case of the preparation of a high grade edible product, a physical method of bleaching *in vacuo* is preferable to a chemical method.

The question of the neutralisation of the free fatty acids necessitates a determination of the acidity of the oil, from which can be calculated the amount of caustic soda refined both for neutralisation and a satisfactory separation of the oil and the alkali layer. An excess of caustic soda must be added; the amount will vary with the particular oil, while the temperature at which the neutralisation process is carried out also affects the separation of the oil and aqueous alkali layer. For example, in the case of palm oil, good results have been obtained using a solution of 10 per cent. caustic soda, adding 10 per cent. in excess of the amount required to neutralise the free fatty acids and carrying out the neutralisation at a temperature of approximately 90°C.

After treatment the neutral oil must be washed with water to remove traces of alkali and dried, preferably *in vacuo,* to remove moisture.

Although the oil has been bleached and neutralised it will still be found to have both odour and taste, either or both of which may be unpleasant, so that if such an oil were used for cooking purposes, the flavour of the food might be masked by that of the oil.

The deodorising system now practically in universal use is one relying on the distillation under reduced pressure of the substances causing the odour and the taste, either in the presence of superheated steam or an inert gas such as nitrogen, preferably the former.

Although a description of the odoriferous constituents present in vegetable oils does not come within the scope of this paper, it may be of interest to mention that such bodies consist of complicated organic compounds, for example,

aldehydes, which tend to change when the oil is heated in air, especially for prolonged periods, but which can be distilled unchanged *in vacuo*. Success in deodorisation depends, therefore, on the absolute exclusion of air both during the process and until the refined oil is cold again. A small leak in the deodoriser may cause a stream of air to pass through the oil and with the high temperature of the superheated steam the flavour of the oil will be entirely spoilt.

It is understood that a common practice is to blow steam superheated to 200°C. through the oil under a vacuum of approximately 29 inches of mercury. In order to give an idea of the amount of vacuum required it may be mentioned that the normal pressure of the atmosphere corresponds to approximately 30 inches of mercury.

The oil should require no further treatment after deodorisation, although it is understood that some refiners take the precaution of filtering the oil to remove traces of moisture, since it is well known that moisture influences the storage qualities of a vegetable oil.

The final product, when liquid, should be clear, bright, tasteless, odourless and neutral. Such an oil, which would be suitable for the highest quality edible purposes, should not revert during any reasonable period of storage prior to consumption.

As mentioned previously, the complete refining of a vegetable oil constitutes a highly complicated technical process and the brief description given above will furnish an idea of the high standard reached in this respect in the industry in Europe.

Hydrogenation of Oil.

When discussing the question of the refining of vegetable oils, a brief reference might be made to the process of hydrogenation, or hardening as it is also called.

The principle of hydrogenation is based on the fact that when an oil is heated with hydrogen in the presence of a catalyst, the unsaturated fatty acids present as glycerides in the oil unite with the hydrogen to form saturated fatty acids. Glycerides, in which the latter type of acids predominate, have a higher solidification point and therefore the fat tends to harden. For example, in the case of hydrogenated palm oil the liquid fraction disappears almost entirely, the product being a soft white fat.

As regards the catalyst the metal nickel in a suitable form is employed.

Further, since the degree of hydrogenation can be varied to suit the particular purpose for which the oil is required, and it is understood that most fats for edible purposes can be further improved and stabilised as a result of slight hydrogenation, the importance of the process will be realised. In this connection it may be mentioned that the marked degree of competition between various oils for a particular industrial purpose can be attributed to a large extent to the development of the hydrogenation process by which, for example, a fish oil

can be transformed into a fat of the consistency of tallow or one of even greater hardness.

It would appear, therefore, as if there were possibilities for such a process locally in the preparation of a vegetable butter as a substitute for ghee, and enquiries have already been made as regards a suitable type of plant for the carrying out of laboratory experiments not only with palm oil, but with other locally-produced vegetable oils.

Remarks and Conclusions.

The results of the investigation indicate that under local conditions the method of air-bleaching offers the best possibilities as regards a simple means of decolourising the oil. The quality of the bleached product can be improved by treatment with alkali to remove the free fatty acids.

The method of separating the fresh oil into its two fractions, solid and liquid, and the possibilities of bleaching each fraction separately are described.

While the product bleached and purified as described, may be regarded as of good quality and having possibilities as a substitute for other locally produced vegetable oils, either for edible purpose or soap-making, such an oil cannot be compared with high grade edible oils as marketed in Europe.

An outline of the complete refining process for a vegetable oil, including a reference to the possibilities of hydrogenation is given.

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(2) Bolton E. R., Oils, Fats and Fatty Foods. Second Edition (1928), page 402.

(3) Sastry S. G., The Catalytic Bleaching of Palm Oil, *Transactions of the Chemical Society*, Vol. CVII, 1915, page 1828.

Reviews.

The Veterinary Journal.

Vol. 88, No. 10, October, 1932. Publishers: Baillièr, Tindall and Cox, 7 and 8 Henrietta St., Covent Gardens, W.C. 2. Price two shillings net or twenty one shillings per annum, post free.

This number is styled "Special Pig Diseases Number" and although the greater portion of the bulletin is devoted to the results of research on diseases, it contains much information on diseases caused by malnutrition. Several articles, which are probably the most interesting to the agriculturist in the tropics, give the latest findings and thought on purely nutrition research.

Some of the General and Clinical articles covering advanced investigations on diseases are written for other veterinary research workers and practitioners, but much of the information in the journal is couched in language that can be followed by the ordinary reader.

The articles on the electro-lethaler for anaesthetising pigs immediately before slaughter commends a humane method which has been in vogue in Germany and England for some time; it is also claimed to be a better and cheaper method than shooting from the slaughterers' and consumers' point of view.

Electric stunning suggests a method of anaesthetising wild and other troublesome animals, for such operations as can be performed in a short space of time. The reviewer is informed that experiments are proceeding at the Singapore abattoirs with this method of stunning before slaughter.

The article on modern nutritional research, amongst other very interesting statements, gives the results of experiments on the feeding of minerals to farm stock. From the results of previous experiments during the past few years, it has become the custom amongst progressive agriculturists to feed elaborate mineral mixtures to all animals as an insurance against a possible mineral deficiency.

The recent experiments show that under pen conditions in England, the simplest and cheapest minerals, with salt, have given equally as good results as the expensive elaborate mixtures.

This article also gives the findings of modern research into the protein requirements of farm animals and shows how proteins of vegetable origin, with minerals added, can replace those derived from animal origin, e.g. milk, meat, and fish meal.

The paper on nutritional anaemia in suckling pigs throws much light on the frequent losses of piglings in litters in Malaya and the so called "bad doers" in litters.

The authors' investigations have been carried out on the assumption that anaemia in suckling pigs is solely caused by a deficiency of iron salts, or alternatively that certain iron salts, if assimilated by young pigs, will help the animals considerably to overcome the low haemoglobin values. The continuation of the

investigations in endeavours to obtain a simple practical method of administering the iron, showed that pigs allowed in the open and free to root up the earth, or pigs that were given plough earth in the pens, showed haemoglobin values as high as any of the animals treated clinically. This appears to indicate that the anaemia may not be altogether due to a deficiency of iron as it is impossible to state that the young pigs were obtaining iron only from the earth or grazing.

The paper on "Asthenia in Piglings" gives a finding of mineral deficiency as the cause of heavy mortality in the litters in a herd of swine, the symptoms however showed no indication of anaemia.

An interesting article on tuberculosis in swine states that this disease in pigs is almost invariably of bovine origin, which explains the reason why Malayan pigs are practically free from tuberculosis, as dairying and pig raising are seldom practised on the same holding.

It has been shown in the paper on lungworms that these parasites live a part of their life cycle in the earthworm and the alternative host is essential for the transference of these parasites from one pig to another. Suitable anthelmintics are unknown for lungworms in pigs, and as a means of prevention it is recommended that young pigs should only be grazed on land that has had no pigs on it for two years.

T. D. M.

Report on Visit to West Indies.

By F. A. Stockdale, C.M.G., C.B.E., Colonial Office, September, 1932.

Mr. F. A. Stockdale, Agricultural Adviser to the Secretary of State for the Colonies in this publication gives a concise account of the activities of the Departments of Agriculture in the West Indies, Burmuda, British Guiana and British Honduras. It is a report of the writer's visit to these colonies undertaken in 1932 to ascertain the present-day conditions of the agricultural industries in the Colonies visited and to study the work being performed by the different Departments of Agriculture to assist these industries.

The Report is of interest to agriculturists in the East by reason of the similarity of crops and of the many agricultural problems discussed which bear a close relationship to those that engage our attention.

Miscellaneous Article.

ENTOMOLOGICAL NOTES.

Fourth Quarter, 1932. B.M.

BY

G. H. CORBETT,

Government Entomologist.

Spraying v. Dusting for Leaf-Eating Caterpillars of Coconuts.

In a recent publication*, the writer referred to some preliminary experiments which were being conducted with power dusters for the control of leaf-eating caterpillars of coconuts. Spraying with lead arsenate has proved effective for this purpose when the caterpillars have been confined to young palms and would, if the machinery were available and the roads, drains and nature of the soil permitted its transport, also prove satisfactory against caterpillars on tall palms. Of the estates in Malaya, however, that can afford to purchase the machinery, only a limited number possess roads suitable for transporting it over the clayey or peaty nature of the soil and for negotiating drains. These transport difficulties militate against the control of leaf-eating caterpillars by spraying. Whilst most coconut estates in Malaya are found on flat land, and therefore the transport of heavy machinery over hills would not have to be overcome, the scarcity of water would probably be found the limiting factor on those estates over which the heavy spraying machinery could be transported.

The control of coconut leaf-eating caterpillars can be accomplished by spraying with lead arsenate but consideration has had to be given to the above mentioned difficulties with the result that measures other than spraying have usually been recommended. These have proved generally satisfactory but cannot be stated to have been as effective as a poisonous spray would have been. For instance, the recommendations for the control of *Setora nitens,* consist in encouraging its parasites, especially the Tachinid, *Chaetexorista javana,* and dislodging the caterpillars by brushing them off the leaves with a bamboo pole to which a coconut husk is attached, and, in the case of the caterpillars of *Artona catoxantha* and *Mahasena corbetti,* in grease banding the trunks to prevent the caterpillars which have reached the ground from re-ascending the palms. In considering these difficulties, dusting appeared to be a possible solution and accordingly enquiries were made as to suitable dusting machines capable of throwing a dust to a height of some 50 or 60 feet. As a result a dusting machine† was found to be available in Malaya and steps were taken to obtain it in order that some preliminary experiments in dusting could be conducted.

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* Corbett, G. H., "Insects of Coconuts in Malaya", Special Bulletin No. 10, General Series 1932, published by the Department of Agriculture, S.S. and F.M.S., page 76.

† "Dustejecta", Manufactured by Drake and Fletcher, Ltd., Maidstone and kindly lent by the Agents, Messrs. Guthrie and Co., Kuala Lumpur.

At the outset the writer must state that equally satisfactory dusters may be on the market and that at present he is not in a position to recommend or otherwise the purchase of this or any other duster for the control of leaf-eating caterpillars, because the results of preliminary trails have already revealed that, although dusting has advantages over spraying machinery in so far that the initial cost of the machinery is decidedly less, that to a very large extent the nature of the soil is overcome because the machine can be carried by four coolies and that dusting is not dependent on water, other factors, even though a dusting machine may be capable of throwing a dust to the height of an ordinary coconut palm, have to be considered and surmounted before dusting can be recommended. In this connection, it may be observed that, since most caterpillar pests of coconuts, *viz., Artona, Chalcoscelis* and *Sctora,* are in the initial stages of attack confined to the oldest leaves, the dust to be effective would not have to be thrown to the height of the youngest leaves.

The degree of fineness of the dust is an important consideration. In America, manufacturers guarantee that 50—70 per cent. will pass through a sieve having 300 meshes to the square inch. Closely associated with fineness is the lightness of the dust and especially important in Malaya is its dryness. Lead arsenate and calcium arsenate are usually employed as dusts and for dusting are diluted with a filler. Hydrated lime generally serves for this purpose, since it is light, cheap and easily prepared. Sulphur is also used as a carrier when the aim is to control an insect pest as well as a fungus disease. In Malaya, consideration would probably have to be given to this filler in order to control the fungus, *Pestalozzia,* which follows the feeding of the young caterpillars of *Chalcoscelis.* Lead arsenate, as a dust, is generally used in the proportion of 1 to 10 of filler, but whether at this strength the caterpillar pests of coconuts are controlled has not been ascertained, although observations appear to show that the amount of lead arsenate would have to be increased. When the strength has been ascertained, the effective quantity of dust per acre of coconuts has to be found and it is possible that dusting, as a general estate practice, may eventually be proved to be too expensive and may have to be limited to small areas where the damage is excessive and to areas where caterpillars have been found to be numerous, so as to prevent tht spread of the moth. Observations undoubtedly indicate that the pests of coconuts are at first confined to small areas and from these foci spread and become generally distributed throughout an estate.

Whilst dusting can be performed quicker than spraying and an attacked area could therefore be covered in less time, it is considered to be less effective than spraying even on trees whose leaves are covered with hairs which assist in retaining the dust. The coconut leaf is smooth, so that, when the leaf is dry, very little dust is held and, though some may be retained, a slight breeze causes it to fall to the ground. Wet leaves do not afford the even distribution of the dust as dry leaves, but in view of the fact that the coconut leaf, when dry, holds but little dust, there would appear to be no alternative but to dust when the

DUSTING COCONUT PALMS.

EXPLANATION OF PLATE.

1. Dust ascending to 40 — 50 feet.
2. Dust descending owing to a top breeze.
3. Wind preventing the dust ascending and causing drift.
4. Dusting from a trolley, showing good distribution.

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leaves are damp, although the dust will be inclined to accumulate in spots. The dusting of palms in Malaya after showers has been tried with quite satisfactory results as the leaves have been found to be well covered with dust after a period of three weeks although in the interval 12″ of rain had fallen.

Another important factor is wind. It has already been stated that a slight breeze when the coconut leaf is dry causes the dust to fall to the ground. In Malaya, the air is more still at night and in the early morning; during the day time, breezes are general which not only prevent the dust from remaining on the leaves but also from reaching the palms or, by raising it above the tops of the palms, cause it to drift.

It is considered that for dusting to be successful in Malaya the operation would generally have to be performed at night when the air is still and when the leaves are damp, but not heavy with dew, so that on the leaf drying the dust would be retained.

At this juncture it may be said that, given suitable climatic conditions, dusting for the control of leaf-eating caterpillars of coconuts appears to have possibilities, but, until more detailed experiments have been conducted, it would be unwise to recommend it. When opportunity affords, further dusting experiments will be made and the strength and the quantity of the mixture for effective control will be the principal considerations, but such work is dependent not only on the presence of leaf-eating caterpillars of coconuts but also on the cooperation of Managers of Estates.

Departmental.

FROM THE DISTRICTS.

The Weather.

Following a very wet November the month of December has been a dry one by comparison. It is nomally a fairly wet month everywhere excepting along the coastal areas of Kedah and Province Wellesley and the coastal tract on the west of Johore. This year, however, rainfall for the month appears to have been below normal throughout the Peninsula. This is perhaps most marked in the case of the east coast. The average precipitation for Kota Bahru for December is 27.49 inches as compared with 13.84 inches recorded for the month under review. Still more marked are the figures for Pekan, in Pahang, where the average for the month on 35 years' records is 28.45 inches as compared with 5.30 inches recorded for December, 1932. This lower preciptation for the month is general and includes the returns from mounain stations as is exemplified in the figures for Cameron Highlands which this December are 3.9 inches as compared with an average monthly preciptation of 11.08 inches, based on 6 years' records. The only instances where returns received exceed the average are Kuala Selangor, 11.46 inches, as compared with an average of 9.01 inches and Johore Bahru, 10.07 inches, as compared with an average for the month of 9.70 inches.

Remarks on Crops.

Rubber.—The price paid for kampong rubber in the various localities shows a slight drop for the month. Price ranges throughout all districts in dollars per picul were 6.00—10.00 for smoked sheet; 5.00—8.40 for unsmoked sheet and 1.00—4.50 for scrap. The corresponding average prices in Singapore for kampong rubber were 9.60 for smoked sheet, $8.70 for unsmoked sheet and $4.20 for scrap.

Little change can be reported in the position with regard to Mouldy rot. In the drier areas such as Province Wellesley, the disease is stated to be much less in evidence but, on the other hand, the unsatisfactory condition with regard to control of the disease is emphasised in reports relating to Bandar Bahru and Kulim Districts of Kedah and the Selama and Briah areas in Perak.

No reliable data is available regrding the percentage of small holdings in tapping, but reports indicate that little change has occurred in this respect during the month.

Padi.—The price at the Bagan Serai Rice Mill remained at $1.80 per picul throughout the month, which is equivalent to 7 cents per gantang and is the same as that reported last month.

Prospects for the coming crop are generally good throughout the Peninsula. In Kedah, a certain amount of flood damage is reported, Thus, in the Kuala Muda District, some 400 acres of newly planted padi was damaged on account of the bund giving way. Similarly, newly planted padi in Kulim was damaged and in the Bandar Bahru District 100 acres of young padi was destroyed, whilst 300 acres were inundated in Kuala Pasu District, 50 acres of which was destroyed. In Province Wellesley, harvesting is in progress in many localities and a good crop is expected. Generally speaking, the floods at the end of November caused little damage, Balik Pulau in Penang being the area most affected. Attacks by the Fulgorid Bug, *Sogata furcifera*, in many parts of the Settlement will doubtless result in some reduction of the crop. In Krian, flowering is generally good throughout Bagan Serai and Briah and has commenced in Gunong Semanggol and Selinsing. In the north east area the crop is making excellent growth. It must be remembered that a fair proportion of padi in north east Krian was planted late and, under such circumstances, a wet harvest may reduce the yield considerably so that the crop harvested may fall short of present expectations for this area. Elsewhere in Perak prospects are good. In Selangor, harvesting was completed in the inland Districts except in the southern part of Ulu Selangor where wet weather and floods have caused much loss of crop to this late planted padi. In the coastal districts transplanting is practically completed. In the Negri Sembilan, harvesting is practically completed in Jelebu, well under way in Seremban, Tampin and Port Dickson Districts and has not been commenced in Kuala Pilah District. In Malacca, harvesting is in progress throughout the Settlement except in some of the coastal mukims, which are always later than the remainder of the Settlement. Crop prospects are generally good in Kelantan, harvesting of short term padi and Tugal padi is in progress and a fair yield is being obtained. Inland areas have suffered to some extent from shortage of water during the month. In Pahang, harvesting is well advanced and yields are reported to be good throughout. As a larger area than usual has been planted this season in Pahang west it is now certain that the crop will prove to be a record one.

In the four districts of west Pahang, investigations indicate that there is an increase of 9,000 acres under padi as compared with last year. In Johore, harvesting is well advanced in Batu Pahat, Muar, Segamat and Kluang. Weather conditions have been suitable in all parts of the State and fair crops are generally expected. Co-operation between the Agricultural and Land officers, coupled with increased interest in the crop shown by cultivators themselves, have resulted in prospects being very much better for padi in Johore than has been the case in the past.

Coconuts.—Further progress in the matter of improvements to kilns and the quality of copra manufactured by small-holders is reported from many parts of the Peninsula. In Province Wellesley, the fact that one Malay owner has received the price ruling for No. 1 grade copra has induced neighbours to follow his example and erect kilns of the pattern recommended by the Department. In

the Bagan Datoh district of Perak there are now over 300 kilns erected and during the month, the Assistant Chemist for Copra Research visited the area to ascertain the present position. Much work is needed to encourage the improvement of many of the kilns erected and consequent improvement of the copra made and to further this object arrangements have been made to send an additional Malay Officer to Bagan Datoh to group the small-holders into suitable units for copra manufacture and to instruct and foster the best methods of manufacture. The Officer selected for this has received training at the Klang Coconut Station in Selangor. In Selangor, progress continues, and there is evidence of improved grouping. Notwithstanding the high price offered for poor copra owing to the keen competition amongst middlemen, the quality of copra made by small-holders continues to show improvement in Sabak Bernam and Kuala Langat Districts. At Batu, in Kuala Langat, a central kiln has been erected by a grower capable of taking the produce from 150 acres and 2 new kilns are under erection at Sabak Bernam. Reports from Pahang state that work has commenced on the construction of a copra kiln at Temerloh, whilst, in in Pahang East, Headmen are making efforts to form a combine to deal with copra from an area of 200 acres.

Cloves.—Attention is drawn by the Field Officer in Province Wellesley to the considerable increase in the price of cloves as compared with last month. The respective quotations per picul being $35 for November and $50 for December.

Weekly Fairs.

Weekly Fairs have received considerable and varied attention of late in most parts of the country. In Kedah, 33 fairs are now held regularly and some progress has been made towards organising them under a committee. In Selangor many fairs are held but there is evidence that further attention is required with regard to their organisation. In Negri Sembilan there is a good attendance, but the quantity of kampong grown vegetables brought forward for sale is small. In Malacca, two new fairs have been started during the month, whilst it is reported that they are becoming increasingly popular in West Pahang, except in the District of Bentong. The present lack of support in this District may be largely due to the fairs being an innovation and increased support may be forthcoming later. In Johore, fairs have been opened at 5 new centres in the Muar District and in one centre at Batu Pahat.

Agricultural and Padi Experiment Stations and Test Plots.

Agricultural Stations.—Considerable progress was made during the month in the establishment of the Station at Bukit Metarjam in Province Wellesley. The erection of buildings is completed and Carpet grass has been dibbled in on paths and road edges. At the Selama Station 3 good types of arecanut have been planted. At Kuala Kangsar, the work of erecting new fowl houses of

an improved type and renovating the stands for the wire netting enclosure is now practically completed and the poultry area presents a much more business-like and finished appearance than before. It is expected that the new type of fowl house erected will prove more suitable for the climate of Malaya than the old design of house. At Tanah Rata, Cameron Highlands, tea seed of 10 varieties imported from India has been sown and seed of a number of varieties of tobacco has been obtained for trial. Improvements to the tea factory are being carried out and are expected to be completed shortly. At Sungei Udang in Malacca fencing of poultry runs was continued and the erection of fowl houses is completed. At Kuala Lipis Station further plantings have been made of grafted fruit trees and a number of varieties of sugar cane have been introduced for trial. At the Singapore Pineapple Station the close planted areas of pines show better growth than those more widely planted, so much so that the close planting arrangement has been followed by certain Chinese in the vicinity.

Padi Stations and Test Plots.—Reports show that the heavily manured plots in the supplementary manurial trials laid down at the Padi Stations and many of the Test Plots are showing considerably better growth than the controls in nearly every case. Reaping has commenced at Pulau Gadong Station and the crop there is maturing rapidly. Reports indicate that the growth of the plants at practically all the Test Plots is very satisfactory. In a few instances, slight trouble has been experienced in the matter of irrigation control. It is worthy of record that 5 out of the 6 Plots in Johore are in a satisfactory condition. Harvesting was completed on one during the month and is in progress on three others and will shortly commence on the fifth. The unsatisfactory Plot is at Ayer Itam, where the crop was completely spoilt by rats.

DEPARTMENTAL NOTES.

Honour for Dr H. A. Tempany, Director of Agriculture, S.S. & F.M.S.

His Majesty the King has been graciously pleased to confer the honour of Commander of the Most Excellent Order of the British Empire (Civil Division) on Harold Augustin Tempany, D.Sc., F.I.C., Director of Agriculture, S.S. and F.M.S.

Tour of the Director of Agriculture.

Dr. H. A. Tempany, Director of Agriculture, S.S. and F.M.S., accompanied by Mr. F. Birkinshaw, Acting Chief Field Officer, made a tour of Perak and Province Wellesley between the 8th and 13th of December. He visited and inspected all Agricultural Stations, Padi Experiment Stations and Test Plots and conferred with the various Administrative and Agricultural Officer throughout these areas.

Coconut Experiment Station - Klang.

The control of this station was taken over from the Division of Economic Botany by the Agricultural Division of the Department of Agriculture in November.

There are now 50 acres under mature palms on the Station; these include both talls and dwarfs; the three types of the latter which are represented are those with red, green and yellow nuts. Present work is mainly concerned with careful recording of monthly yields of nuts obtained from individual palms throughout the entire area. Since these palms present a collection of desirable types, the records, when taken over a sufficiently long period, will form a basis for selection work with this important crop. In the immature portion of 30 acres, only part of which is planted, a collection of palms raised from nuts obtained by the Agriculturist during a visit to Ceylon are making good progress.

School of Agriculture, Malaya.

The School closed for the holidays on December 22nd and will be reopened on February 1st.

There are at present 30 students in the School.

Progress examinations were held during December, the results of which were, with a few exceptions, satisfactory.

The Field Instructional work during December included the planting of 1½ acres with three clones of budded rubber stumps, obtained from the Rubber Research Institute, the establishment of a germination nursery for selected coconut seed and the limeing and re-planting of the vegetable garden. The students paid a visit to the Experimental Plantation, Serdang, and received instruction in the various activities which were then in progress.

Mr. W. A. Stanton has been appointed a member of the Advisory Committee for the School of Agriculture in place of the late Mr. J. S. Arter.

Visit of Agricultural Field Officer, Singapore, to Labuan and Brunei.

Mr. D. G. P. Olds, Agricultural Field Officer—Singapore visited Labuan and Brunei during the months of November and December for the purpose of inaugurating agricultural services in these two territories in accordance with recommendations made by the Director of Agriculture as a result of his visit in August last. It is proposed to inaugurate small Agricultural Departments in both areas and steps are being taken to recruit and train the necessary Malay staff, while proposals are under consideration for the establishment of a number of small demonstration and test stations.

Leave and Transfers.

The leave of absence granted to Mr. B. Bunting, Agriculturist, has been extended, on medical grounds, for a period of two months from 22nd January, 1933.

Mr. A. E. C. Doscas, officiating as Senior Agricultural Officer, Perak, proceeded on leave of absence on December 24th 1932. Mr. F. R. Mason, Agricultural Field Officer, Province Wellesley and Penang, is replacing him as Senior Agricultural Officer, Perak, while Mr. J. A. Baker is acting as Agricultural Field Officer, Province Wellesley and Penang.

Mr. W. N. Sands returned from leave of absence on January 6th and resumed duty as Principal Agricultural Officer, Kedah.

Mr. J. Fairweather, who officiated as Principal Agricultural Officer, Johore, during the absence on leave of Mr. F. de la Mare Norris, assumed duty as Agricultural Field Officer, Johore North, on 23rd November, 1932.

Statistical.

MARKET PRICES.

December, 1932.

Rubber.—The Singapore price of rubber smoked sheet equal to London Standard in December showed a gradual decline throughout December from 7 7/8 cents to 7 1/16 cents per lb., the average price for the months being 7.54 cents per lb., as compared with 7.75 cents in November. The average London price in December was 2.48d. per lb., and New York 3.20 cents (gold) per lb., as compared with 2.56d. and 3.39 cents (gold) respectively in November.

The average price per lb., in 1932 was as follows:—Singapore 6.97 cents, London 2.39d., New York 3.35 cents (gold) per lb. compared with 9.78 cents, 3.13d., and 6.07 cents (gold) respectively for the year 1931.

Palm Oil.—During the first half of December the market was steady at £18.15.0 per ton; the price dropped to £18 per ton during the latter half of the month, closing at this price with a downward tendency.

The average price for 1932 of cabled quotations c.i.f. Liverpool on a basis of 18 per cent. f.f.a. was £17.16.9 as compared with £18.8.3 for 1931.

Copra.—The market has shewn a decline in prices during the month, Sundried being quoted at $5.80 per picul at the beginning of the month and $5.55 at the end of the month. The average price in December for this quality was $5.72 per picul, as compared with $5.81 in November: "Mixed" averaged $5.20 per picul in December as compared with $5.28 in November.

The average Singapore price of Sundried copra in 1932 was $5.74 per picul as compared with $5.09 for 1931. Mixed averaged $5.22 per picul in 1932 as compared with $4.64 in 1931.

Coffee.—Singapore prices of Palambang coffee were steady in December, the average price for the month being $19.90 per picul as compared with $19.38 in November. The average price in Singapore of Sourabaya coffee was $22.20 to $24.50, the price within this range depending upon quality.

The average prices in Singapore for the year 1932 were Palambang $17.74, Sourabaya $24.12 per picul.

Arecanuts.—The Singapore average price in December for Palambangs was $2.65 as compared with $2.64 in November. Bila Whole averaged $3 as compared with $2.81 per picul in November. Average Singapore prices per picul of other grades in December were:—Splits $4.05 to $5.95; Red Whole $4.70 to $5.46; sliced $5.45 to $6.90—Kelantans were unquoted.

The average Singapore prices per picul for arecanuts during the year 1932 were as follows:—Palambang $3.10, Bila Whole $3.27, Splits $6.30, Red Whole $7.08, Sliced $10.77, Kelantan Split $6.44.

Rice.—The average wholesale price of Siam No. 2 ordinary rice per picul in Singapore in November was $3.79 as compared with $3.68 in October. No. 1 Rangoon rice averaged $3.41 per picul in Singapore in November as compared with $3.41 in October.

The average retail market prices in cents per gantang of No. 2 Siam rice in November were :—Singapore 30, Penang 30, Malacca 27, as compared with 30, 30 and 28 respectively in October.

Gambier.—Prices have fallen still further, Block closing at $5 and Cube No. 1 to $9.50 per picul. The average prices for December were Block $5.20, Cube No. 1 $9.80 per picul, as compared with $5.88 and $10.19 respectively in November.

Average prices per picul in 1932 were Cube No. 1 $14.73 and Block $8.24 as compared with $17.33 and $10.59 in 1931.

Pineapples.—Supplies of fresh fruit have been scarce resulting in a slight firming of the prices of canned pineapples. Average prices per case in December were Cubes $3.07, Sliced flat $2.85, Sliced tall $3.26 as compared with $2.95, $2.84 and $3.24 respectively in November.

The average prices per case for the year 1932 were as follows :—Cubes $3.34, Sliced flat $3.27, Sliced tall $3.48 as compared with $3.51, $3.29 and $3.49 in 1931.

Tapioca.—Prices have remained practically unchanged, Singapore average prices per picul for December being—Flake, fair $3.70, Pearl seed $4.12 and Pearl medium $4.22, as compared with $3.32, $3.98 and $4.08 respectively in November.

Average Singapore prices for the year 1932 were Flake fair $3.22, Pearl seed $4.05, Pearl medium $4.26, as compared with $3.60, $4.67 and $5.71 in the year 1931.

Sago.—The average Singapore prices per picul in December were :—Pearl small, fair $3.98, Flour, Sarawak, fair $2.15 as compared with $4.07 and $2.29 respectively in November.

The demand in December was uncertain, Eastern Ports requirements at one time caused an advance in prices which, however, were not maintained.

The Singapore average prices picul for the year 1932 were as follows :—Pearl, small fair $4.24, Flour, Sarawak, fair $2.24 as compared with $5.01 and $2.34 respectively in 1931.

Mace and Nutmegs.—The Singapore market has been dull with little enquiry. Prices are more or less nominal for mace, Siouw being quoted throughout the month at $62 per picul and Amboina at $40.

Average prices for nutmegs in December were :—110 per lb. $25.20 per picul, 80 per lb. $30.60 per picul as compared with $23.75 and $29.50 per picul in previous month.

Average prices per picul for the year 1932 were as follows :—Mace. Siouw $59.37, Amboina $41.59. Nutmegs 110 per lb. $24.84, 80 per lb. $30.29.

Pepper.—The market has been quiet with importers generally not pressing sales. Average Singapore prices per picul in December were :—Singapore black $17.25, Singapore White $21.65, Muntok white $22.15 as compared with $17.25, $22.44 and $22.94 in November.

Average Singapore prices per picul for the year 1932 were :—Singapore black $19.64, Singapore White $25.07, Muntok White $25.61.

Cloves.—Market featureless nominal prices being quoted at Zanzibar $40 and Amboina $45.

Average Singapore quotations during 1932 (monthly nominal prices were) Zanzibar $43.75, Amboina $47.19.

The above prices are based on London and Singapore daily quotations for rubber; on the Singapore Chamber of Commerce Weekly Reports for the month and on other local sources of information. Palm oil reports are kindly supplied by Messrs. Cumberbatch & Co., Ltd., Kuala Lumpur, and the Singapore prices for coffee and arecanuts by the Lianqui Trading Company of Singapore.

1 picul = 133⅓ lbs. The Dollar is fixed at two shillings and four pence.

Note.—The Department of Agriculture will be pleased to assist planters in finding a market for agricultural produce. Similar assistance is also offered by the Malayan Information Agency, 57, Charing Cross, London, S.W.1.

GENERAL RICE SUMMARY*

November, 1932.

Malaya.—Gross foreign imports of rice (including stocks available for re-export) during November, 1932, amounted to 52,474 tons as compared with 50,109 tons in November, 1931, of which 44.9 per cent. were consigned to Singapore, 19.7 per cent. to Penang, 9.7 per cent. to Malacca, 19.3 per cent. to the Federated Malay States and 6.4 per cent. to the Unfederated Malay States.

Of these imports 58.6 per cent. were from Siam, 37.4 per cent. from Burma, 2.8 per cent. from Indo-China and 1.2 per cent. from other countries.

Total foreign exports of rice from Malaya in November, 1932, were as follows (in tons) :—

Siam rice 11,464, Burma rice 5,161, Indo-China rice 753, Indian rice 10, local production rice 165 : Total 17,553 tons.

Of these exports 84.1 per cent. went to the Netherlands East Indies and 15.9 per cent. to other countries.

The exports during November 1931 were 15,815 tons.

Net imports for the period January to November, 1932, were 370,105 tons as compared with 480,970 tons for the same period of 1931, a fall of 23.1 per cent.

India and Burma.—Total foreign exports of rice (*Indian Trade Journal* 8.12.32) during October, 1932, were 72,000 tons as compared with 144,000 tons in September, 1932, and 135,000 tons in October, 1931, decreases of 50.0 per cent. in respect of the previous month and 46.7 per cent. in respect of the same period of the previous year.

Total exports during period January to October, 1932, were 1,866,000 tons as compared with 1,806,000 tons for the corresponding period of 1931, an increase of 60,000 tons or 3.3 per cent.

Total exports of rice and bran from Burma for the period January 1 to December 3, 1932, amounted to 2,894,313 tons as compared with 3,344,463 tons for the corresponding period of 1931, or a decrease of 13.5 per cent.

Quotations at Rangoon on 30.11.32 for white rice of 100 baskets of 75 lbs. each were Rs. 180 for Big Mills Specials and Rs. 185 for Small Mills Specials as compared with Rs. 186 and Rs. 198 on 2.11.32 and Rs. 213 and Rs. 233 on 2.12.31.

The Third Forecast of the Rice Crop in Burma for the season 1932-33 issued on December 15, 1932, gives the area likely to mature as 12,257,700 acres, being 167,400 acres or 1.4 per cent. more than the final figures of last year.

The estimated outturn (states the Forecast) is 7,444,200 tons of padi which is 796,200 tons or 12.0 per cent. more than the corresponding estimate of the previous season.

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* Abridged from the Rice Summary for November 1932, compiled by the Department of Statistics S.S. and F.M.S.

The years' exportable surplus is estimated at 4,662,000 tons of padi which may be taken as equivalent to 3,450,000 tons of rice and rice products.

Japan.—According to the second rice-crop forecast for 1932, (*Trans-Pacific Journal,* dated November 17, 1932) the yield is estimated to be 8,440,180 tons, a decrease of 2.2 per cent. from the first crop forecast and an increase of 9.0 per cent. over the actual crop of 1931.

Siam.—Exports (approximate) of rice from Bangkok during November, 1932, amounted to 135,908 tons as compared with 98,679 tons in November, 1931, or an increase of 37.7 per cent.

Exports of rice from Bangkok during the period December, 1931, to November, 1932, (the figures for August to November, 1932, being approximate) amounted to 1,505,412 tons, an increase of 319,796 tons or 27.0 per cent. as compared with the same period of 1930-31.

At the end of October, 1932, (Principal Trade Commissioner, Ministry of Commerce and Communications, Bangkok) the area under padi in 60 provinces amounted to 7,308,000 acres, an increase of 252,000 acres or 3.6 per cent. as compared with the same period of 1931.

Netherlands India.—Java and Madura. The *Korte Berichten* of November 25, 1932, states that at the end of October, 1932, the area harvested amounted to 8,650,250 acres, an increase of 393,750 acres or 4.8 per cent. as compared with the same period of 1931, the area damaged to 348,042 acres a decrease of 118,785 acres or 25.4 per cent. as compared with 1931 and additional plantings awaiting harvesting to 1,018,500 acres a decrease of 54,250 acres as compared with 1931, a total of 10,016,792 acres as compared with 9,796,076 acres for the same period of 1931 an increase of 2.3 per cent.

Imports of rice into Java and Madura during January to October, 1932, totalled 122,244 tons as compared with 243,751 tons for the same period of 1931, or a fall of 49.8 per cent.

Imports of rice into Outer Provinces during January to September, 1932, totalled 192,829 tons as compared with 246,492 tons for the same period of 1931 or a fall of 21.8 per cent.

French Indo-China.—Entries of padi at the port of Cholon from January 1, 1932, to November 30, 1932, amounted to 1,048,934 (metric) tons, an increase of 18,188 tons or 1.8 per cent. as compared with the same period of 1931.

Exports of rice from Saigon for the period January 1, 1932, to November 30, 1932, amounted to 1,090,497 (metric) tons, an increase of 192,936 tons or 21.5 per cent. as compared with the same period of 1931.

Ceylon.—Imports for 10 months October 31, 1932, were 371,819 tons, an increase of 4,835 tons or 1.3 per cent. as compared with 1931.

Of these imports 20.4 per cent. were from British India, 69.3 per cent. from Burma, 0.4 per cent. from the Straits Settlements and 9.9 per cent. from other countries.

Europe and America.—Quantities of rice shipped from the East were :—

(*a*) To Europe period January 1 to November 24, 1932, 948,430 tons as compared with 1,026,938 tons for the same period of 1931, a decrease of 7.7 per cent. Of the 1932 shipments 52.6 per cent. was from Burma, 2.4 per cent. from Japan, 36.9 per cent. from Saigon, 5.3 per cent. from Siam and 2.8 per cent. from Bengal, as compared with 57.6 per cent. from Burma, 7.1 per cent. from Japan, 27.6 per cent. from Saigon, 5.4 per cent. from Siam and 2.3 per cent. from Bengal in 1931.

(*b*) To the Levant, period January 1 to October 17, 1932, 47,145 tons, a decrease of 13,355 tons or 23.3 per cent. as compared with the same period of 1931.

(*c*) To the West Indies and America, period January 1 to October 22, 1932, 114,740 tons, a decrease of 20,040 tons or 14.9 per cent. as compared with the same period of 1931.

INTERNATIONAL GROCERS' EXHIBITION, 1932.

The International Grocers' Exhibition, which opened on September 17th and closed on September 23rd, was held, as usual, in the Agricultural Hall, Islington, London.

The Malaya Stand was situated at the extreme end of one side of the Empire Marketing Board section.

Apart from the exhibits on the Malayan stand, a section of the "Empire Shop-Window" was allotted, in which was set a good range of Malayan products suitable to the occasion.

A very attractive display was made of Malayan tinned pineapple in its various packings and labellings. Only "Golden Quality" was displayed. Tins were kept open on the counter to enable visitors to sample the contents, and the comments made on both the colour and the flavour were very favourable. Liaison was effected between the importing firms and a large number of distributors who hitherto had stocked only the produce of competing countries, and it is understood that much satisfactory business has accrued, or is in process of accruing, as the direct result.

In addition, the stand displayed some really good Malayan tapioca and sago. Hitherto the Malayan exhibits staged at exhibitions had always been under the handicap of only having available tapioca of a dark colour and inferior appearance generally. The samples provided this time, however, were white and well graded; experts pronounced them equal to, if not better than, the Netherlands Indian products, and there was the great advantage that they were considerably lower in price. Genuine business inquiries were received from a large number of well-known firms.

MALAYAN AGRICULTURAL EXPORTS, NOVEMBER, 1932.

PRODUCT.	NET EXPORT IN TONS.				
	Year 1931	Jan-Nov. 1931	Jan-Nov. 1932	November 1931	November 1932
Arecanuts ...	19,266	17,553	18,549	1,440	2,428
Coconuts fresh ...	10,468	8,565	200,588†	1,416	9,981†
Coconut oil ...	9,909	9,035	10,649	906	1,437
Copra ...	100,809	90,999	90,690	11,419	12,543
Gambier, all kinds ...	2,563	2,398	2,771	195	225
Palm kernels ...	726	644	1,098	90	125
Palm oil ...	4,574	3,925	7,300	460	1,010
Pineapples Canned ...	59,457	52,287	60,510	3,160	3,807
Rubber § ...	434,857	395,020	376,163	38,612	34,031
Sago—flour ...	5,608	4,081	9,293	2,080	1,815
„ —pearl ...	2,429	2,213	2,953	338	237
„ —raw ...	2,904*	2,053*	3,833*	295*	503*
Tapioca—flake ...	9,742	8,889	8,346	653	500
„ —flour ...	491*	410*	88	143*	220
„ —pearl ...	19,006	17,130	18,567	1,194	2,003
Tuba root ...	74	63	114½	15	9

† '000 in number. * net imports. § Production.

ACREAGE OF TAPPABLE RUBBER OUT OF TAPPING IN NETHERLANDS INDIA AT END OCTOBER, 1932.

	A Totally Ceased		B Partly Ceased		Total A & B	
	Estates	Area in Acres	Estate	Area in Acres	Estates	Area in Acres
Java and Madura ...	190	104,036	49	12,315	239	116,351
Outer Provinces ...	207	89,396	61	30,539	268	119,935
Total Netherlands India ...	397	193,432	110	42,854	507	236,286

The total area out of tapping for the month of October amounts to 25 per cent. of the total tappable area as at end of December, 1931.

ACREAGE OF TAPPABLE RUBBER OUT OF TAPPING ON ESTATES OF 100 ACRES AND OVER, MALAYA, AT THE END OF NOVEMBER, 1932.

State or Territory	Acreage of Tappable Rubber end 1931	Estates which have entirely ceased tapping		Estates which have partly ceased tapping		Total (3) + (5)	Percentage of (7) to (2)
		Acreage	Percentage of (3) to (2)	Acreage	Percentage of (5) to (2)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Federated Malay States :—							
Perak	238,420	14,662	6.1	31,806	13.3	46,468	19.5
Selangor	294,030	17,984	6.1	37,376	12.7	55,360	18.8
Negri Sembilan	217,002	18,851	8.7	21,756	10.0	40,607	18.7
Pahang	35,122	8,122	23.1	3,979	11.3	12,101	34.4
Total F.M.S. ...	784,574	59,619	7.6	94,917	12.1	154,536	19.7
Straits Settlements :—							
Province Wellesley	44,055	2,336	5.3	8,937	20.3	11,273	25.6
Dindings	6,700	310	4.6	1,139	17.0	1,449	21.6
Malacca	110,288	5,201	4.7	21,693	19.7	26,894	24.4
Penang Island	1,585	776	48.9	236	14.9	1,012	63.8
Singapore Island	28,033	13,014	46.4	3,999	14.3	17,013	60.7
Total S.S. ...	190,661	21,637	11.3	36,004	18.9	57,641	30.2
Unfederated Malay States :—							
Johore	313,385	41,874	13.4	35,312	11.3	77,186	24.6
Kedah (*a*)	114,254	11,114	9.7	7,112	6.2	18,226	16.0
Kelantan	16,785	5,666	33.8	1,417	8.4	7,083	42.2
Trengganu (*b*)	4,300	Nil	Nil	2,072	48.2	2,072	48.2
Perlis	903	106	11.7	462	51.2	568	62.9
Total U.M.S. ...	449,627	58,760	13.1	46,375	10.3	105,135	23.4
Total Malaya ...	1,424,862	140,016	9.8	177,296	12.4	317,312	22.3

Notes :—1. (*a*) Registered companies only and are rendered quarterly, commencing with June 1931.
(*b*) Registered Companies only.
The above table together with a Summary was prepared and published by the Statistics Department, S.S. and F.M.S. on October 26, 1932.

MALAYA RUBBER STATISTICS — TABLE I

STOCKS, PRODUCTION, IMPORTS AND EXPORTS OF RUBBER, INCLUDING LATEX, CONCENTRATED LATEX AND REVERTEX, FOR THE MONTH OF NOVEMBER, 1932 IN DRY TONS.

Territory	Stocks at beginning of month 1			Production by Estates of 100 acres and over		Production by Estates of less than 100 acres estimated 2		Imports				Exports including re-exports				Stocks at end of month		
								during the month		during the year 1932		during the month		during the year 1932				
	Ports	Dealers	Estates of 100 acres and over	during the month	during the year 1932	during the month	during the year 1932	Foreign	From Malay States	Foreign	From Malay States	Foreign	Local	Foreign	Local	Ports	Dealers	Estates of 100 acres and over
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
MALAY STATES :—																		
Federated Malay States	...	15,039	11,709	10,909	127,578	6,847	83,289	Nil	Nil	Nil	Nil	13,307	5,290	150,731	64,259	...	13,927	11,958
Johore	...	2,831	3,027	3,477	39,997	3,837	38,575	Nil	5	Nil	69	1,002	6,340	10,787	67,878	...	2,751	3,084
Kedah	...	735	1,999	2,213	24,797	1,283	10,718	Nil	Nil	Nil	Nil	643	2,767	7,273	28,029	...	825	1,995
Perlis	...	32	12	8	74	14	72	Nil	Nil	Nil	Nil	Nil	19	Nil	133	...	34	13
Kelantan ...	...	176	151	153	1,594	575	2,869	28	Nil	422	Nil	48	621	538	4,145	...	250	164
Trengganu ...	...	55	50	100	1,135	50	569	Nil	Nil	Nil	Nil	Nil	150	Nil	1,704	..	55	50
Total Malay States	...	18,868	16,948	16,860	195,175	12,606	136,092	28	5	422	69	15,000	15,187	169,329	166,148	...	17,842	17,264
STRAITS SETTLEMENTS																		
Malacca ...	...	3,609	1,361	1,377	14,852	2,482	22,404	Nil	15,223	Nil	166,336	4,187	Nil	44,941	Nil	...	4,339	1,315
Province Wellesley	...	120	646	469	4,935			Nil		Nil						...	192	652
Dindings ...	...	99	76	90	1,000			Nil		Nil		5,015		56,770		...	67	68
Penang	655	4,286	11	4	30			468		4,431						1,150	4,492	15
Singapore ...	3,786	18,156	215	143	1,675			7,218		60,063		15,896		167,094		3,524	20,314	207
Total Straits Settlements	4,441	26,270	2,309	2,083	22,492	2,482	22,404	7,686	15,223	64,494	166,336	25,098	Nil	268,805	Nil	4,674	29,404	2,257
TOTAL MALAYA	4,441	45,138	19,257	18,943	217,667	15,088	158,496	7,714	15,228	64,916	166,405	40,098	15,187	438,134	166,148	4,674	47,246	19,521

TABLE II
DEALERS' STOCKS, IN DRY TONS 6

Class of Rubber	Federated Malay States	S'pore	Penang	Province We'sly D'dings M'cca.	Johore	Total
20	21	22	23	24	25	26
DRY RUBBER	11,102	17,918	3,906	4,344	974	38,244
WET RUBBER	2,825	2,396	586	254	1,777	7,838
TOTAL ..	13,927	20,314	4,492	4,598	2,751	46,082

TABLE III
FOREIGN EXPORTS

PORTS	For month	during the year 1932
Singapore ...	25,898	273,615
Penang ...	8,159	99,438
Port Swettenham.	5,287	55,864
Malacca ...	754	9,217
MALAYA ...	40,098	438,134

TABLE IV
DOMESTIC EXPORTS 7

AREA	For month	during the year 1932
Malay States ...	32,490	372,846
Straits Settlements		
MALAYA ...	32,490	372,846

Notes :—1. Stocks on estates of less than 100 acres and stocks in transit on rail, road or local steamer are not ascertained.

2. The production of estates of less than 100 acres is estimated from the formula : Production + Imports + Stocks at beginning of month = Exports + Stocks at end of month, + Consumption, *i.e.*, Column [7] = Columns [13] + [14] + [17] + [18] + [19] + [19A] — [2] — [3] — [4] — [5] — [9] — [10]. For the Straits Settlements, Columns [7] and [8] represent purchases by dealers from local estates of less than 100 acres, reduced by 15% to terms of dry rubber.

3. Dealers' stocks in the Federated Malay States are reduced to dry weights by the following fixed ratios: unsmoked sheet, 15%; wet sheet, 25 ; scrap, lump, etc., 40%; stocks elsewhere are in dry weights as reported by the dealers themselves.

4. Domestic exports are estimated by deducting the average monthly dry weight of foreign imports over a period of 2 months from the gross foreign exports of the later month, the foreign exports of the Malay States being domestic production.

5 The above, with certain omissions, is the Report published by the Registrar-General of Statistics, S.S. and F.M.S., at Singapore on 21st October, 1932.

METEOROLOGICAL SUMMARY, MALAYA, NOVEMBER, 1932.

Locality	Air Temperature in degrees Fahrenheit							Earth Temperature		Rainfall								Bright Sunshine		
	Means of			Absolute Extremes						Total		Most in a day	Number of days					Total	Daily Mean	Per cent
	A. Max.	B. Min.	Mean of A and B	Highest Max.	Lowest Min.	Lowest Max.	Highest Min.	At 1 foot	At 4 feet			Amt.	Precipitation .01 in or more	Precipitation, .05 in or more	Thunder-storm	Fog morning obs.	Gale force 8 or more			
	°F	°F	°F	°F	°F	°F	°F	°F	°F	in.	mm.	in.						hr.	hr.	%
Railway Hill, Kuala Lumpur, Selangor ...	88.6	72.2	80.4	93	71	80	74	82.9	84.1	15.53	394.5	4.07	23	23	6	2		131.70	4.39	37
Bukit Jeram, Selangor ...	85.6	72.1	78.9	88	70	75	74	82.9	84.7	12.96	329.2	1.98	22	19				161.20	5.37	45
Sitiawan, Perak ...	87.0	72.9	79.9	91	71	78	75	82.8	84.2	13.30	337.8	4.08	25	20	2			156.90	5.23	44
Kroh, Perak ...	83.9	69.7	76.8	88	67	76	72	79.6	81.2	17.37	441.2	2.95	27	24	5	3		124.30	4.14	35
Temerloh, Pahang ...	87.1	72.7	79.9	91	71	79	75	83.5	84.9	15.36	390.1	3.34	25	22	1	8		129.20	4.31	36
Kuala Lipis, Pahang ...	87.1	71.4	79.3	91	70	82	73	82.6	83.7	9.52	241.8	1.85	26	22	3	21		145.85	4.86	41
Kuala Pahang, Pahang ...	85.3	73.2	79.3	91	71	79	75	82.9	84.6	12.36	313.9	3.59	23	13	3			157.15	5.24	44
Mount Faber, Singapore ...	86.1	73.4	79.7	90	71	78	76	81.4	82.7	4.51	114.6	1.14	15	9	2		3	168.75	5.63	47
Butterworth, Province Wellesley ...	84.8	73.4	79.1	87	72	78	75	82.6	84.2	17.81	452.4	8.22	24	19	2	1	1	154.90	5.16	44
Bukit China, Malacca ...	83.6	72.7	78.1	86	71	80	76	81.5	83.2	13.06	331.7	2.25	26	19	1			164.15	5.47	46
Kluang, Johore ...	86.8	71.4	79.1	90	70	78	73	81.3	82.1	12.65	321.3	3.75	22	17	1	7		129.70	4.32	36
Bukit Lalang, Mersing, Johore	85.4	71.7	78.5	91	70	79	73	80.5	81.3	14.02	356.1	2.50	24	21	3			126.40	4.21	35
Alor Star, Kedah ...	85.3	73.7	79.5	89	72	79	76	83.3	84.9	12.59	319.8	2.65	20	17	6	2		155.70	5.19	44
Kota Bahru, Kelantan ...	84.9	73.1	79.0	88	71	77	75	82.9	84.2	20.97	532.6	5.06	23	20				151.85	5.06	43
Kuala Trengganu, Trengganu	84.5	72.1	78.3	88	71	78	74	80.6	82.5	32.51	825.8	6.39	24	23	1			178.30	5.94	50
HILL STATIONS.																				
Fraser's Hill, Pahang 4268 ft. Pahang ...	71.6	61.3	66.5	76	60	65	63	70.5	71.1	15.52	394.2	2.89	26	24	4	8		81.65	2.72	23
Cameron Highlands, Tanah Rata, Pahang 4750 ft. ...	70.0	59.0	64.5	74	55	64	61	69.2	69.2	15.36	390.1	1.63	30	26	1	10		82.45	2.75	23
Cameron Highlands, Rhododendron Hill, Pahang 5120 ft. ...	69.5	58.9	64.2	74	57	62	60			15.84	402.3	1.62	29	24		4		87.70	2.92	25

Compiled from Returns supplied by the Meteorological Branch, Malaya.